MATERIA MEDICA
PHARMACY, PHARMACOLOGY
AND
THERAPEUTICS

THIRD EDITION

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MATERIA MEDICA

PHARMACY, PHARMACOLOGY
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MATERIA MEDICA
PHARMACY, PHARMACOLOGY
AND
THERAPEUTICS

BY

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OF GENERAL THERAPEUTICS'

THIRD EDITION

LONDON
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Errata

Page xi, line 12, *omit* rectified

,, xii, line 6 from bottom, *for* Sandal Wood is called Sanders Wood, *read* Red Sandal Wood is called Red Sanders Wood

White's Materia Medica

PREFACE TO THE THIRD EDITION

THIS edition has been thoroughly revised, it contains numerous additions and all the very many alterations necessitated by the publication in 1898 of a new edition of the 'British Pharmacopœia.' These amounted to several hundreds. The following lists of some of the chief changes may be found useful by those readers who are accustomed to the 1885 edition of the Pharmacopœia.

The following appear for the first time in the 1898 edition of the 'British Pharmacopœia.'

Araroba
Argenti Nitras Induratus
Aurantii Cortex Recens
Benzol
Bismuthi Salicylas
Caffeinæ Citras Effervescens
Caoutchouc
Carbonis Bisulphidum
Cocaina
Codeinæ Phosphas
Extractum Belladonnæ Liquidum
Extractum Ipecacuanhæ Liquidum
Extractum Jaborandi Liquidum
Extractum Nucis Vomicæ Liquidum
Extractum Strophanthi
Glycerinum Acidi Borici
Glycerinum Pepsini
Hydrargyri Oleas
Hyoscynæ Hydrobromidum
Hyoscyaminæ Sulphas
Infusum Scoparii
Kaolinum
Lamellæ Homatropinæ
Liquor Calumbæ Concentratus
Liquor Caoutchouc
Liquor Chiratæ Concentratus
Liquor Cuspariæ Concentratus

Liquor Ethyl Nitritis
Liquor Hamamelidis
Liquor Hydrogenii Peroxidi
Liquor Krameriæ Concentratus
Liquor Morphinæ Tartratis
Liquor Pancreatis
Liquor Picis Carbonis
Liquor Quassiæ Concentratus
Liquor Rhei Concentratus
Liquor Sarsæ Compositus Concentratus
Liquor Senegæ Concentratus
Liquor Sennæ Concentratus
Liquor Serpentariæ Concentratus
Liquor Thyroidei
Lithii Citras Effervescens
Morphinæ Tartras
Naphthol
Oleum Pini
Oleum Rosæ
Paraffinum Liquidum
Physostigminæ Sulphas
Pilula Quininæ Sulphatis
Pix Carbonis Preparata
Pruni Virginianæ Cortex
Quillaiæ Cortex
Quininæ Hydrochloridum Acidum
Salol
Spiritus Anisi
Strychninæ Hydrochloridum
Suppositoria Acidi Carbolici
Suppositoria Belladonnæ
Syrupus Aromaticus
Syrupus Calcii Lactophosphatis
Syrupus Cascaræ Aromaticus
Syrupus Codeinæ
Syrupus Ferri Phosphatis cum Quinina et Strychnina
Syrupus Glucosi
Syrupus Pruni Virginianæ
Terebenum
Thyroideum Siccum
Tinctura Ergotæ Ammoniata
Tinctura Pruni Virginianæ
Tinctura Quillaiæ
Trochiscus Acidi Carbolici
Trochiscus Eucalypti Gummi
Trochiscus Guaiaci Resinæ
Trochiscus Krameriæ
Trochiscus Krameriæ et Cocainæ
Unguentum Aquæ Rosæ
Unguentum Capsici
Unguentum Cocainæ
Unguentum Hydrargyri Oleatis
Unguentum Hydrargyri Oxidi Flavi
Unguentum Paraffini

The following, which were in the 1885 edition of the 'British Pharmacopœia,' are omitted from the 1898 edition (those marked with an asterisk are transferred to the Appendix for testing purposes).

Acetum
Acidum Lacticum Dilutum
Acidum Meconicum
Aconiti Folia
*Alcohol Amylicum
Ammonii Nitras
Anisi Stellati Fructus
Aqua
Argentum Purificatum
Aurantii Fructus
Berberinæ Sulphas
Belæ Fructus
Bismuthi Citras
Bismuthi et Ammonii Citras

Bismuthum
Bismuthum Purificatum
*Bromum
Calamina Preparata
*Calcii Sulphas
Canellæ Cortex
Carbo Animalis
Carbo Animalis Purificatus
Cataplasmata (all)
Cerevisiæ Fermentum
Cetraria
Charta Epispastica
Cinchonæ Cortex (C. Rubræ Cortex is retained)
Cinchonidinæ Sulphas
Cinchoninæ Sulphas
Confectio Opii
Confectio Rosæ Caninæ
Confectio Scammonii
Confectio Terebinthinæ
Creta
Cupri Nitras
*Cuprum
Decoctum Cetrariæ
Decoctum Cinchonæ
Decoctum Hordei
Decoctum Papaveris
Decoctum Pareiræ
Decoctum Quercûs
Decoctum Sarsæ
Decoctum Sarsæ Compositum
Decoctum Scoparii
Decoctum Taraxaci
Ecbalii Fructus
Elemi
Emplastrum Ferri
Emplastrum Galbani
Emplastrum Saponis Fuscum
Enemata (all)
Essentiæ (all)
Extractum Aconiti
Extractum Aloes Socotrinæ
Extractum Belæ Liquidum
Extractum Calumbæ
Extractum Colchici Aceticum
Extractum Conii
Extractum Gelsemii Alcoholicum
Extractum Hæmatoxyli
Extractum Jaborandi
Extractum Lactucæ
Extractum Lupuli
Extractum Mezerei Æthereum
Extractum Papaveris
Extractum Pareiræ
Extractum Quassiæ
Extractum Rhamni Frangulæ
Extractum Rhamni Frangulæ Liquidum
Farina Tritici
Ferri Peroxidum Hydratum
Ferri Sulphas Granulata
Glycerinum Acidi Gallici
Gutta Percha
Hordeum Decorticatum
Hydrargyri Persulphas
Infusum Anthemidis
Infusum Catechu
Infusum Cusso
Infusum Jaborandi
Infusum Lini
Infusum Maticæ
Infusum Valerianæ
Kamala
Lac
Lactuca
Laricis Cortex
Liquor Ammonii Acetatis Fortior
Liquor Ammonii Citratis Fortior
Liquor Antimonii Chloridi
Liquor Calcii Chloridi
*Liquor Chlori
Liquor Ferri Acetatis Fortior
Liquor Ferri Dialysatus
Liquor Gutta Percha
Liquor Iodi
Liquor Lithiæ Effervescens

Liquor Magnesii Citratis
Liquor Morphinæ Bimeconatis
Liquor Morphinæ Sulphatis
Liquor Potassæ Effervescens
Liquor Sodæ
Liquor Sodæ Effervescens
*Magnesii Oxidum Nigrum
Manna
*Marmor Album
Mastiche
Maticæ Folia
Mel
Mica Panis
Mistura Ferri Aromatica
Mistura Scammonii
Mori Succus
Morphinæ Sulphas
*Mucilago Amyli
Nectandræ Cortex
Oleatum Hydrargyri
Oleatum Zinci
Oleo-resina Cubebæ
Oleum Myristicæ Expressum
Oleum Pini Sylvestris
Oleum Rutæ
Oleum Sabinæ
Os Ustum
*Ovi Albumen
*Ovi Vitellus
Physostigmina
Pilula Conii Composita
Pilula Ferri Carbonatis
Pilula Ferri Iodidi
Plumbi Nitras
Potassii Cyanidum
*Potassii Ferrocyanidum
Quercûs Cortex
Rhamni Frangulæ Cortex
Rosæ Caninæ Fructus
Rosæ Centifoliæ Petala
Sabadilla
Sabinæ Cacumina
Santonica
*Soda Caustica
Sodii Nitras
Sodii Valerianas
Spiritus Tenuior
Suppositoria Acidi Carbolici cum Sapone
Suppositoria Acidi Tannici cum Sapone
Suppositoria Hydrargyri
Suppositoria Morphinæ cum Sapone
Syrupus Ferri Subchloridi
Syrupus Mori
Syrupus Papaveris
Tabaci Folia
Theriaca
Tinctura Aurantii (made with dried peel)
Tinctura Chloroformi Composita
Tinctura Ergotæ
Tinctura Ferri Acetatis
Tinctura Gallæ
Tinctura Laricis
Tinctura Lobeliæ
Tinctura Sabinæ
Tinctura Valerianæ
Tinctura Veratri Viridis
Tinctura Zingiberis Fortior
Trochisci Opii
Unguentum Antimonii Tartarati
Unguentum Calaminæ
Unguentum Elemi
Unguentum Potassæ Sulphuratæ
Unguentum Sabinæ
Unguentum Simplex
Unguentum Terebinthinæ
Uvæ
Vapores (all)
Veratri Viride Rhizoma
Vinum Aloes
Vinum Opii
Vinum Rhei
*Zincum
*Zincum Granulatum

The following are some of the more important alterations (the alterations are so numerous that it is not safe to prescribe without consulting the new edition of the Pharmacopœia or a book constructed from it) :—

Most of the doses have been changed.

The strength of many preparations has been altered. In the case of tinctures this has been done to render the doses more uniform (*see* p. 22).

Many additional preparations have been standardized (*see* p. 7).

The words proof and rectified applied to spirit have been discarded, and the percentage of alcohol is always stated (*see* p. 250).

The descriptions of many chemical processes are left out, and those of others are curtailed.

The colour of the following is markedly altered, because saffron is omitted from them :—

Tinct. Opii Ammoniata, Tinct. Rhei, Pulv. Cretæ Aromaticus, and Pulv. Cretæ Aromaticus cum Opio.

A few of the Botanical names are altered.

Aconita. This name is given to a definite alkaloid
Adeps Preparatus is called Adeps
Æther Purus is called Æther Purificatus
Alcohol Ethylicum is called Alcohol Absolutum
Apomorphinæ Hydrochloras is called Apomorphinæ Hydrochloridum
Aqua Chloroformi. The strength of this is halved
Argenti et Potassii Nitras is called Argenti Nitras Mitigatus
Coca is called Cocæ Folia
Cocainæ Hydrochloras is called Cocainæ Hydrochloridum
Cubeba is called Cubebæ Fructus
Ergotinum is called Extractum Ergotæ
Extractum Belladonnæ is called Extractum Belladonnæ Viride
Extractum Hyoscyami is called Extractum Hyoscyami Viride
Ferri Arsenias is called Ferri Arsenas

Ferri Carbonas Saccharata is called Ferri Carbonas Saccharatus
Ferri Sulphas Exsiccata is called Ferri Sulphas Exsiccatus
Gelsemium is called Gelsemii Radix
Granati Radicis Cortex is called Granati Cortex
Homatropinæ Hydrobromas is called Homatropinæ Hydrobromidum
Injectio Ergotini Hypodermica is called Injectio Ergotæ Hypodermica
Injectio Morphinæ Hypodermica is a preparation of the Tartrate instead of the Acetate of Morphine
Ipecacuanha is called Ipecacuanhæ Radix
Jaborandi is called Jaborandi Folia
Limonis Succus is called Succus Limonis
Lini Farina is called Linum Contusum
Lini Semina is called Linum
Linimentum Camphoræ Compositum is called Linimentum Camphoræ Ammoniatum
Linimentum Iodi is called Liquor Iodi Fortis
Linimentum Sinapis Compositum is called Linimentum Sinapis
Liquor Ammoniæ Fortior is called Liquor Ammoniæ Fortis
Liquor Cocainæ Hydrochloratis is called Injectio Cocainæ Hypodermica
Liquor Ferri Perchloridi Fortior is called Liquor Ferri Perchloridi Fortis
Liquor Morphinæ Hydrochloratis is called Liquor Morphinæ Hydrochloridi
Liquor Plumbi Subacetatis is called Liquor Plumbi Subacetatis Fortis
Liquor Sodii Arseniatis is called Liquor Sodii Arsenatis
Liquor Strychninæ Hydrochloratis is called Liquor Strychninæ Hydrochloridi
Morphinæ Hydrochloras is called Morphinæ Hydrochloridum
Oleum Sinapis is called Oleum Sinapis Volatile
Pepsin is called Pepsinum
Pilula Asafœtida Composita is called Pilula Galbani Composita
Pilulæ. Syrup of Glucose replaces treacle as a basis
Pyroxylin is called Pyroxylinum
Quininæ Hydrochloras is called Quininæ Hydrochloridum
Sandal Wood is called Sanders Wood
Sodii Arsenias is called Sodii Arsenas
Sodii Carbonas Exsiccata is called Sodii Carbonas Exsiccatus
Strophanthus is called Strophanthi Semina
Syrupus Rosæ Gallicæ is called Syrupus Rosæ
Tabella Nitroglycerini is called Tabella Trinitrini

Tinctura Aconiti is about half its former strength
Tinctura Aurantii Recentis is called Tinctura Aurantii
Tinctura Belladonnæ is about double its former strength
Tinctura Chloroformi et Morphinæ is called Tinctura Chloroformi et Morphinæ Composita and it is different in strength and composition
Tinctura Nucis Vomicæ is about double its former strength.
Tinctura Rhei is called Tinctura Rhei Composita
Tinctura Sennæ is called Tinctura Sennæ Composita
Tinctura Strophanthi is about half its former strength
Trochisci. These are nearly all made differently
Trochisci Bismuthi is called Trochiscus Bismuthi Compositus
Unguenta. The bases of nearly all these have been altered.

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MATERIA MEDICA

Materia Medica is so wide a term that it is difficult to define. It includes the following:

(*a*) **Materia Medica proper,** sometimes called Pharmacognosy. This is the knowledge of the natural history, physical characters, and chemical properties of drugs.

(*b*) **Pharmacy.**—This is the science and art of the preparation and combination of drugs, so as to render them fit for administration.

(*c*) **Pharmacology.**—This is the science which treats of the actions of drugs on the body both in health and disease. A subdivision of it is Pharmacodynamics, which is the science of the physiological action of drugs in health. The science which studies the effects of doses large enough to endanger life is **Toxicology.**

(*d*) **Therapeutics** is the science and art of alleviating or curing disease. Many authors do not include this under the term Materia Medica. Therapeutics is either—

(1) **Rational,** when we have sufficient knowledge of the disease and the pharmacological action of the remedy to know

why it should be of benefit, *e.g.* The use of digitalis for mitral disease.

(2) **Empirical**, when our knowledge is insufficient to tell us why the remedy is efficient, *e. g.* The use of mercury for syphilis.

Therapeutics ought not to be included in the term Materia Medica, for that treats only of drugs; but Therapeutics, properly speaking, is concerned with all means of alleviation.

General Therapeutics is a subdivision of Therapeutics; it is the science and art of alleviating disease by such remedies as are not drugs, *e.g.* diet, climate, baths, venesection, cupping, &c. In this work we shall consider only that part of Therapeutics which is concerned with drugs.

A Pharmacopœia is a book published by some authorised body, generally constituted by law. This book describes the medicines in common use, and states the doses in which they may safely be given. The pharmacopœias and the authorities publishing them differ in different countries. The **British Pharmacopœia** is published by the General Medical Council. The last edition appeared in 1898, and a list of the chief changes made by it will be found in the preface. As new drugs are discovered they are, if of use, included in new editions of the Pharmacopœia. Everything contained in the Pharmacopœia is said to be "official." The abbreviation for "British Pharmacopœia" is "**B. P.**"

MATERIA MEDICA PROPER.

As much of this as the student need know will be mentioned under each drug.

PHARMACY.

Pharmacy is for the most part carried out by the manufacturing and dispensing chemist. The medical student should, however, be acquainted with the simpler processes, as he may have to perform them. They are best learnt in the dispensary. An elementary knowledge of chemistry will enable him to understand most of the terms used in pharmacy, but the following should be noticed.

Alkaloids are bodies having the following characteristics :

(1) They are the active nitrogenous principles of organic bodies.

(2) They are compound ammonias : that is to say, one or more atoms of hydrogen in ammonia (NH_3) are replaced by various radicals.

(3) They combine with acids to form crystalline salts without the production of water.

(4) They are alkaline, turning red litmus paper blue.

(5) Very few are liquid, such as pilocarpine, conine, nicotine, sparteine, lobeline. Liquid alkaloids nearly always contain only carbon, hydrogen, and nitrogen.

(6) The solid ones are colourless, crystalline, and contain oxygen.

(7) They are sparingly soluble in water, readily so in alcohol.

(8) The solutions are intensely bitter.

(9) Most of them are closely related to pyridine, and some may be synthetically prepared from pyridine bases.

Names of alkaloids terminate in English in *ine* (quinine) in Latin in *ina* (quinina). Examples in B. P.: Atropine, Cocaine, Strychnine, &c. Except in the case of Aconitine, Atropine, Caffeine, Cocaine, Codeine, Strychnine, and Veratrine, salts of alkaloids, but not alkaloids themselves, are official.

Glucosides are crystalline bodies which when acted upon by acids, or chemical ferments (enzymes), split up into glucose and other substances (alcohols, aldehydes, phenols, etc.), different in each case.

Example in B. P. Salicinum. Many varieties of tannic acid exist in plants as Glucoses.

Neutral Principles are indifferent proximate crystalline principles whose chemical characters have not been determined.

Examples in B. P.: Aloinum, Elaterinum.

Fixed Oils are salts of the higher fatty acids which at ordinary temperatures remain liquid. The usual fatty acids entering into the composition of fixed oils are oleic, palmitic, and stearic.

Example: Olive oil consists of a mixture of a combination of oleic acid ($C_{18}H_{34}O_2$) with glyceryl (C_3H_5) and palmitic acid ($C_{16}H_{32}O_2$) with glyceryl. That is to say, ordinary olive oil is a mixture of two oils having the formulæ $C_3H_5(C_{18}H_{33}O_2)_3$ and $C_3H_5(C_{16}H_{31}O_2)_3$ respectively. When acted upon by caustic alkalies or metallic oxides fixed oils form soaps (oleates, palmitates, or stearates of metals) and glycerin. This process is called saponification, *e.g.* $C_3H_5(C_{18}H_{33}O_2)_3 + 3NaHO = 3NaC_{18}H_{33}O_2 + C_3H_5(OH)_3$.
Hard soap. Glycerin.
Sodium oleate.

Fixed Oils are obtained by expression from the fruits or seeds of plants, or from animal tissues. When pure usually they are yellow, and float on water; they cause a greasy mark on paper. They are called fixed because they cannot be distilled without decomposition. They are soluble in ether or chloroform.

Liquid fixed oils in B. P. are Olea Amygdalæ, Crotonis, Lini, Morrhuæ, Olivæ, Ricini.

Fats are fixed oils which are solid at ordinary temperatures; if extracted by expression sufficient heat to melt them must be used.

Examples in B. P.: Oleum Theobromatis, Adeps.

Volatile or Essential Oils only resemble fixed oils in being soluble in the same media. They do not leave a greasy mark on paper. They are mostly inflammable, and lighter than water. They are highly aromatic, and sufficiently soluble in water to impart their odour and taste to it. Most are prepared by distillation—that is, by passing a current of steam through the substance from which they are extracted, the steam is condensed, and the oil either floats to the top or sinks to the bottom of the water. A few, as oil of lemon, are obtained by expression from a fruit. Their composition varies very much. They contain Aldehydes (Cinnamic Aldehyde, in oil of cinnamon), Phenol derivatives (Eugenol, in oil of cloves), Esters or Ethereal Salts (Methyl Salicylate, in oil of wintergreen), Alcohols (Menthol in oil of peppermint), or Ketones (Carvol in oil of carraway), generally associated with Terpenes of varying composition, and which may be the chief constituent of the oil (*e.g.* the Terpenes in oils of turpentine).

Examples in B. P.: Olea Anethi, Anisi, Cinnamomi, Lavandulæ, Terebinthinæ, &c.

Resins are very complex bodies. They are among the products of oxidisation of volatile oils. They contain many indifferent substances and acids. They are soluble in alkalies, forming resin soaps. Hence the alkali in Decoctum Aloës Compositum, Tinctura Guaiaci Ammoniata, and Tinctura Valerianæ Ammoniata. They are insoluble in water, but not in alcohol, therefore they may be prepared by extraction with alcohol and precipitation with water; also this is the reason for the precipitate which falls when water is added to a resinous tincture.

The B. P. resins are Resina, Resina Guaiaci, Jalapæ, Podophylli, Scammoniæ, and Picis Burgundicæ.

Oleo-resins are natural solutions of resins in volatile oils.

Those in B. P. are Copaiba, Terebinthina Canadensis, Thus Americanum.

Balsams are mixtures of oleo-resins with benzoic acid or cinnamic acid, or with both.

Those in B. P. are Benzoinum, Balsamum Peruvianum, Balsamum Tolutanum, Styrax Præparatus.

Gums are exudations from the stems of plants containing one or more of:

(*a*) Arabin or soluble gums, *e.g.* Acacia.
(*b*) Bassorin or partially soluble gums, *e.g.* Tragacantha.
(*c*) Cerasin or insoluble gum.
Solutions of gum are precipitated by alcohol.

Gum-resins are exudations from plants consisting of a mixture of gums and resins. When they are rubbed with water the gum dissolves, and the resin remains mechanically suspended in the solution.

The B. P. gum-resins are Ammoniacum, Asafetida, Cambogia, Myrrha, and Scammonium.

An Emulsion consists of finely divided particles of an oil, fat, or resin suspended in a liquid having a high specific gravity. When a heavy powder, *e.g.* bismuth subnitrate, is suspended in such a liquid, the result is called a suspension.

Mucilago Acaciæ and M. Tragacanthæ are frequently used to form emulsions. Mucilago Acaciæ should be recently prepared. It is incompatible with iron perchloride, borax, and lead subacetate.

Lotio Hydrargyri Nigra is an example in B. P. of suspension.

Emulsions are coagulated by acids, an undue proportion of metallic salts, and alcoholic liquids.

PHARMACEUTICAL PROCESSES.

Many of these, as filtration, precipitation, &c., need no explanation, but the following require a few words.

Levigation consists in reducing a drug to powder by triturating it with a little water and drying the resulting paste.

Elutriation consists in diffusing an insoluble powder in water, letting the heavier part settle, then decanting the supernatant fluid. The heavier powder in this is allowed to settle, the fluid decanted, and so on until a fluid containing powder of the required fineness is obtained.

Lixiviation consists in the extraction with water of the soluble matter of the ashes of anything which has been ignited, the solution being called a "lye."

Maceration consists in leaving coarsely powdered solid organic substances, in contact for some time, at the temperature of the atmosphere, with a liquid. The resulting solution may be concentrated by heat. Many extracts and tinctures are made by maceration.

Percolation is a process for obtaining the soluble constituents of a drug by the descent of a solvent through it. The drug to be percolated is packed in a tall vertical cylinder, tied over at its lower end with muslin. The percolating fluid, or **menstruum**, is poured in at the top of the cylinder, and as it drops out through the muslin it is collected. The **Marc** is the material after its exhaustion by maceration or percolation. Many concentrated liquors, liquid extracts, and tinctures of vegetable drugs are prepared by percolation.

Scaling.—Scale preparations are made by drying concentrated solutions of drugs on glass plates. The solid left behind forms a thin film on the plate, and this film is broken up. Some preparations of iron are scale preparations.

Standardizing.—The Pharmacopœia directs that certain preparations made from vegetable drugs shall be standardized—that is to say, shall be made to contain a certain fixed proportion of the chief active principle. The standardized preparations are (N.B.—1 per cent. equals 1 grain in 110 minims)—

Extractum Opii containing 20 per cent. of Morphine.
Extractum Opii Liquidum containing 0·75 per cent. of Morphine.
Tinctura Opii containing 0·75 per cent. of Morphine.
Extractum Nucis Vomicæ containing 5 per cent. of Strychnine.
Extractum Nucis Vomicæ Liquidum containing 1·5 per cent. of Strychnine.
Tinctura Nucis Vomicæ containing 0·25 per cent. of Strychnine.

Extractum Belladonnæ Alcoholicum containing 1 per cent. of total alkaloids of the root.

Extractum Belladonnæ Liquidum containing 0·75 per cent. of total alkaloids of the root.

Tinctura Belladonnæ containing 0·05 per cent. of total alkaloids of the root.

Emplastrum Belladonnæ containing 0·5 per cent. of total alkaloids of the root.

Linimentum Belladonnæ containing 0·37 per cent. of total alkaloids of the root.

Unguentum Belladonnæ containing 0·6 per cent. of total alkaloids of the root.

Extractum Cinchonæ Liquidum containing 5 per cent. of total alkaloids.

Tinctura Cinchonæ containing 1 per cent. of total alkaloids.

Tinctura Cinchonæ Composita containing 0·5 per cent. of total alkaloids.

Acetum Ipecacuanhæ containing 0·1 per cent. of total alkaloids.

Extractum Ipecacuanhæ Liquidum containing 2·0 to 2·5 per cent. of total alkaloids.

Vinum Ipecacuanhæ containing 0·1 per cent. of total alkaloids.

Aqua Laurocerasi containing 0·1 per cent. of real Hydrocyanic Acid.

Tinctura Jalapæ containing 1·5 per cent. of jalap resin.

WEIGHTS. MEASURES. SYMBOLS.

Weights (Avoirdupois Weight).

1	grain	. . .	Symbol,	gr.
437·5	,,	= one ounce	,,	℥
16	ounces	= one pound	,,	℔

The Scruple (20 grains, symbol ℈) is rarely used, and the Drachm (60 grains, symbol ʒ) is commonly used, but neither is official. What is known as Apothecaries' Weight, in which the ounce = 480 grains, is not official, and is obsolete in this country, but is sometimes used in America.

Measures of Capacity.

1 minim		Symbol,	♏
60 minims . . .	= one fluid drachm	,,	ʒ
8 fluid drachms (480 minims)	= one fluid ounce	,,	℥
20 fluid ounces . . .	= one pint	,,	O
8 pints . . .	= one gallon	,,	C

Occasionally ʒ and ℥ are written f ʒ and f ℥ when they stand for fluid drachms and fluid ounces.

Relations of Measures to Weights.

1 minim is the measure at 62° F. of 0·911 grains of water.
1 fluid drachm ,, ,, 54·687 ,, ,,
1 fluid ounce ,, ,, 437·5 ,, ,,
(the avoirdupois ounce)
1 pint ,, ,, 8750·0 grains of water.
1 gallon ,, ,, 70000·0 ,, ,,

A **1 per cent. solution** is approximately **a grain in 110 minims.**

A fluid grain is the volume of one grain of water at 62° F., that is to say it is a little over a minim.

In the pharmacopœial description of the various proportions which several parts of a compound bear to one another, the word parts means parts by weight ; the term fluid parts signifies the volume of an equal number of parts of water.

Metrical System.—This, which is as follows, is official on the Continent and in the B. P. for the making of drugs and preparations.

WEIGHTS.

1 milligramme = 0·001 gramme.
1 centigramme = 0·01 ,,
1 decigramme = 0·1 ,,
1 gramme = weight of 1 cubic centimetre of distilled water at 4° C. Abbreviation, grm.
1 dekagramme = 10·0 grammes.
1 hectogramme = 100·0 ,,
1 kilogramme = 1000·0 ,, Abbreviation, kilo.

MEASURES.

1 millilitre = 1 cubic centimetre (abbrev., c.c.) = the measure of 1 grm. of water at 4° C.
1 centilitre = 10 c.c. = the measure of 10 grms. of water.
1 decilitre = 100 ,, = ,, ,, 100 ,, ,,
1 litre = 1000 ,, = ,, ,, 1000 ,, (1 kilo.) of water

Conversion of British to Metrical.

WEIGHTS.

1 grain = 0·0648 grm.
1 ounce = 28·3495 grms.
1 pound = 453·5924 ,, (rather under ½ a kilo.).

MEASURES.

1 minim = 0·059 c.c.
1 fluid drachm = 3·55 ,,
1 fluid ounce = 28·417 ,,
1 pint = 568·336 ,, (rather over ½ a litre),
1 gallon = 4·545 litres.

Conversion of Metrical to British.

WEIGHTS.

1 milligramme = 0·015432 grain.
1 gramme = 15·432 grains.
1 kilogramme = 15432·356 ,, = 2 lbs. 3 oz. 119·8 grs.

MEASURES.

1 cubic centimetre = 16·95 minims.
1 litre (1000 c.c.) = 35·275 fluid ounces, or 1·76 pint.

In prescribing on the Continent all liquids are weighed, the weight of liquids and solids is expressed in grammes, and this word is omitted. Thus—

Mag. Sulph. 20·0 = 20 grammes of Magnesium Sulphate.
Hydrarg. Subchlor. 0·5 = half a gramme of Mercurous Chloride.
Tinctura Rhei 1·5 = a gramme and a half of Tinctura Rhei.

The following approximately accurate table will be useful:

1 ♏ or 1 grain = ·06 gramme.
1 drachm (ʒ) = 3·5 grammes.
1 ounce (℥) = 30·0 ,,

Domestic Measures.

A TEA-SPOONFUL is about a fluid drachm. Usually it is a little more, viz. 5 c.c. nearly.

A DESSERT-SPOONFUL is about two fluid drachms.

A TABLE-SPOONFUL is about half a fluid ounce. Usually it is almost 20 c.c.

A WINE-GLASSFUL is about one and a half to two fluid ounces.

A TEA-CUPFUL is about five fluid ounces.

A BREAKFAST-CUPFUL is about eight fluid ounces.

A TUMBLERFUL is about eleven fluid ounces.

A DROP is often taken as being about a minim, but drops vary so much in size that they should never be used for children nor as a measure of powerful drugs. For example, the number of drops in a fluid drachm of the United States syrup of acacia is 44, of water 60, of alcohol 146, of chloroform 250.

PHARMACOPŒIAL PREPARATIONS AND THEIR DOSES.

Most drugs are not, in their natural state, fit for administration. They are either too bulky, too nauseous, or contain noxious principles. Preparations suitable for administration are therefore prepared from them according to "official" pharmacopœial directions. The Pharmacopœia states the doses of the various drugs and their preparations which may safely be given to an adult, but these doses are often not rigorously kept in prescribing. They vary with the purpose for which the drug is required and the age of the patient (see Prescribing). The following is an account of the preparation of the pharmacopœial preparations, and the attempt has been made to arrange the doses so as to make them easy to remember.

Aceta.—Solutions of the active principles of the drug extracted from it by maceration or digestion with acetic acid (not vinegar). The B. P. contains three.

	Dose.		*Dose.*
Acetum Cantharidis	Ext. use only.	Acetum Ipecacuanhæ — Scillæ	10–30♏.

Acetum Ipecacuanhæ is standardized (*see* p. 7).

Aquæ.—Aqueous solutions impregnated with some volatile substance.

Those in the B. P. directed to be made by distilling the drug with water are—

	Dose.		*Dose.*
Aqua Anethi — Anisi — Aurantii Floris — Carui — Cinnamomi	1–2℥.	Aqua Fœniculi — Pimentæ — Rosæ — Sambuci	1–2℥.

Aqua Laurocerasi (Standardized 0·1 per cent. of Hydrocyanic Acid) **1–2**℥ (note dose).

Aqua Aurantii Floris and Aqua Rosæ are prepared by dilution of commercial orange flower water and commercial rose water, which are made by distillation.

Two are directed to be made by distilling the essential oil with water :

	Dose.		*Dose.*
Aqua Menthæ Piperitæ	1–2℥.	Aqua Menthæ Viridis	1–2℥.

In actual practice all Aquæ made from substances containing volatile oils are very often prepared by adding to water the volatile oil with some calcium phosphate to diffuse it through the water, which is filtered off and forms the Aqua. The Pharmacopœia allows this method to be used in hot climates.

Two are simple solutions in cold water :

	Dose.		*Dose.*
Aqua Camphoræ (The solution is aided with alcohol)	1–2℥.	Aqua Chloroformi (1 in 401)	1–2℥.

Charta (papers).—Cartridge paper coated with an active compound and used as a plaster. The B. P. contains one :

Charta Sinapis (for mode of preparation see Mustard).

Collodia (collodions).—Solutions of pyroxylin in ether or ether and alcohol. When applied externally a protective film is formed owing to the rapid volatilization of the solvent. The B. P. contains three :

Collodium
— Flexile
Collodium Vesicans

Confectiones (Syn. Electuaries, boluses, conserves).—Powders made into a paste with sugar or honey, of such a consistency that the powders do not separate, but the mass can be swallowed. The B. P. contains four :

	Dose.		Dose.
Confectio Rosæ Gallicæ	Used as a basis for pills.	Confectio Piperis — Sennæ — Sulphuris	1–2ʒ.

Decocta.—Solutions of the non-volatile active principles of vegetable drugs, made by boiling the ingredients in distilled water, in a covered vessel, for from 5 to 10 minutes, and straining. The dose of each of the three in the B. P. is ½ to 2℥. They are :

Decoctum Aloës Co.
— Granati Radicis
Decoctum Hæmatoxyli

Emplastra.—Plasters consist of tenacious, pliable, solid substances spread upon calico or leather. They are only used for application to the skin, to which they adhere at the temperature of the body. The following list from the B.P. shows that ALL BUT THREE ARE DERIVED FROM E. PLUMBI :

Emplastrum Plumbi	Oxide of lead, olive oil, and water. OLEATE OF LEAD AND GLYCERIN ARE FORMED.
— Hydrargyri — Plumbi Iodidi — Resinæ — Saponis	Lead plaster is the basis.
— Belladonnæ — Calefaciens — Opii	Resin plaster, which is made from lead plaster, is the basis.
— Cantharidis	Soap plaster, which is made from lead plaster, is the basis.
— Menthol — Picis	Resin is the basis.
— Ammoniaci cum Hydrargyro	Olive oil is the basis.

Extracta.—Concentrated preparations made by evaporating either the expressed juice of plants, or a solution of the soluble constituents of dried drugs. If the solid extract would otherwise be too poisonous, it may be diluted with sugar of milk (Ex. Belladonnæ Alcoholicum, Ex. Nucis Vomicæ, Ex. Opii, Ex. Physostigmatis, and Ex. Strophanthi).

In Ex. Cinchonæ Liquidum, Ex. Ergotæ, and Ex. Ipecacuanhæ Liquidum, *q.v.*, special substances are used to facilitate the extraction of the active principles, and Ex. Euonymi Siccum contains Calcium Phosphate to keep the extract in the form of a powder. Extracts are of different kinds.

(1) **Fresh Extracts.**—Heat the juice expressed from the bruised plant to 212° F. to coagulate the albumen, filter, evaporate the filtrate at 160° F. The B. P. contains Ex. Colchici and Taraxaci. Green extracts are a variety of fresh extracts that needs special notice.

(2) **Green Extracts.**—Heat the expressed juice to 130° F. to coagulate the green colouring matter, filter it off; heat the filtrate to 200° F. to coagulate the albumen. Evaporate the filtrate at 140° F. to a syrupy consistency; add the green colouring matter (which prevents absorption of moisture and improves the appearance), and evaporate the whole. The B. P. contains only two, Ex. Belladonnæ Viride and Hyoscyami Viride.

(3) **Aqueous Extracts.**—Treat dry drugs with cold, hot, or boiling water, and evaporate to a proper consistency. Examples: Ex. Opii, &c.

(4) **Alcoholic Extracts.**—Treat dry drugs with alcohol with or without the addition of water, and evaporate to a proper consistency. Examples: Ex. Cannabis Indicæ, Jalapæ, &c. In some cases the solid extract is made by evaporation of the official liquid extract, *e.g.* Ex. Nucis Vomicæ and Belladonnæ Alcoholicum.

(5) **Ethereal Extracts.**—The dry drug is percolated with ether (Ex. Filicis Liquidum), or with alcohol and ether which are distilled off (Ex. Strophanthi).

(6) **Liquid Extracts.**—These are aqueous, or alcoholic, or aqueous and alcoholic extracts evaporated to form concentrated liquid solutions of syrupy consistence. If aqueous, some alcohol is added to prevent decomposition, and to precipitate any albuminous matter, which is then removed by filtration. Examples: Ex. Ergotæ Liquidum, Hydrastis Liquidum, &c.

Most liquid extracts are of such a strength that one fluid ounce represents one ounce of the drug employed.

Solid Extracts.	Approximate Dose.
Extractum Belladonnæ Alcoholicum	¼–1 gr.
— — Viride	
— Cannabis Indicæ	
— Colchici	
— Nucis Vomicæ	
— Opii	
— Physostigmatis	
— Stramonii	
— Strophanthi	
— Euonymi Siccum	1–2 gr.
— Aloes Barbadensis	1–4 gr.
— Anthemidis	2–8 gr.
— Cascaræ Sagradæ	
— Colocynthidis Co.	
— Ergotæ	
— Gentianæ	
— Hyoscyami Viride	
— Jalapæ	
— Rhei	
— Glycyrrhizæ	5–15 gr.
— Krameriæ	
— Taraxaci	

Liquid Extracts.	Approximate Dose.
Extractum Belladonnæ	½–3 ♏.
— Ipecacuanhæ	
— Nucis Vomicæ	
— Cinchonæ	5–15 ♏.
— Hamamelidis	
— Hydrastis	
— Jaborandi	
— Opii	5–30 ♏.
— Cimicifugæ	10–40 ♏.
— Ergotæ	
— Cascaræ Sagradæ	½–2 ʒ.
— Cocæ	
— Filicis	
— Glycyrrhizæ	
— Pareiræ	
— Taraxaci	
— Sarsæ	2–4 ʒ.

The alcoholic extract of Belladonna, and the extracts of Nux Vomica and Opium, and the liquid extracts of Belladonna, Nux Vomica, Cinchona, Ipecacuanha, and Opium are standardized (*see* p. 7).

In hot countries if any liquid extract contains less than 25 per cent. of alcohol (90 per cent.) this may be increased to 25 per cent. to prevent fermentation.

Glycerina.—Solutions of drugs in glycerin. They are liquid preparations, except Glycerinum Tragacanthæ and Glycerinum Amyli, which are semi-solid. All are for external application except Glycerinum Tragacanthæ (used to make pills) and Glycerinum Pepsini. The B. P. contains—

Glycerinum Acidi Borici
— Acidi Carbolici
— Acidi Tannici
— Aluminis
— Amyli
Glycerinum Boracis
— Pepsini
— Plumbi Subacetatis
— Tragacanthæ

Infusa.—Solutions made by pouring boiling distilled water upon the drug to be extracted, then covering up the vessel, agitating from time to time, usually for a quarter of an hour, sometimes for half an hour, sometimes for one hour, and straining. The filtrate is the infusion.

Inf. **Calumbæ** and Inf. **Quassiæ** are made with **Cold Water,** to prevent the solution of the starch calumba contains and the solution of too much of the bitter principle quassia contains.

Two are compound, viz. Inf. Aurantii Co., Inf. Gentianæ Co.

Two contain acid: Inf. Cinchonæ Acidum, Inf. Rosæ Acidum.

The dose of all is ½—1℥, except Inf. Buchu, Cuspariæ, Ergotæ, Lupuli, Scoparii, all 1—2℥, and **Inf. Digitalis 2—4 fluid drachms.**

Infusions should be made fresh, as they readily decompose.

Injectiones.—Concentrated solutions for injection under the skin. The B. P. contains—

		Strength.	*Dose.*
Injectio Apomorphinæ Hypodermica		(1 per cent.)	5—10♏.
,, Cocainæ	,,	(10 per cent.)	2—5♏.
,, Ergotæ	,,	(33 per cent. of the Extract of Ergot)	3—10♏.
,, Morphinæ	,,	(5 per cent. of Morphine Tartrate)	2—5♏.

Lamellæ.—Small thin discs made with gelatin and glycerin, and used to drop into the eye. Their weight varies from $\frac{1}{50}$ to $\frac{1}{30}$ grain each. The B. P. contains—

Lamella Atropinæ (each contains $\frac{1}{5000}$ gr. atropine sulphate).

Lamella Cocainæ (each contains $\frac{1}{50}$ gr. cocaine hydrochloride).

Lamella Homatropinæ (each contains $\frac{1}{50}$ gr. of homatropine hydrobromide).

Lamella Physostigminæ (each contains $\frac{1}{1000}$ gr. physostigmine sulphate).

Linimenta.—Applications of an oily or spirituous consistence, all of which are intended to be rubbed into the skin except Lin. Aconiti, which is painted on it, and Lin. Calcis, which is simply applied to it. Most contain camphor, many contain olive oil, some contain alcohol or glycerin.

Liquores.—Solutions generally of definite chemical bodies, and in which the solvent is usually distilled water. In many cases these are the only constituents. The substance dissolved is not a definite chemical body, and special solvents are used for Liq. Caoutchouc, Hamamelidis, Pancreatis, Thyroidei, and Picis Carbonis. Special solvents are also used for Liq. Epispasticus and Ethyl Nitritis, and in others solution is aided by the addition of other substances to the water.

The following strengths should be remembered:

	Strength.		*Strength.*
Liquor Arsenicalis	1 p. c. or 1 gr. in 110♏, or about 4½ gr. in ℥j.	Liquor Morphinæ Hydrochloridi	1 p. c. or 1 gr. in 110♏, or about 4½ gr. in ℥j
— Arsenici Hydrochloricus		— — Tartratis	
— Arsenii et Hydrargyri Iodidi		— Potassii Permanganatis	
— Atropinæ Sulphatis		— Sodii Arsenatis	
— Morphinæ Acetatis		— Strychninæ Hydrochloridi	
		— Trinitrini	
— Hydrargyri Perchloridi			½ gr. in ℥j

The following are the doses of Liquors:

	Approximate Dose.		*Approximate Dose.*
Liquor Trinitrini	½—2♏.	Liquor Ferri Acetatis	5—15♏.
— Atropinæ Sulphatis		— — Perchloridi	
— Arsenicalis	2—8♏.	— — Pernitratis	
— Arsenici Hydrochloricus		— — Thyroidei	
— Sodii Arsenatis		—Ammoniæ	10—30♏.
— Strychninæ Hydrochloridi		— Arsenici et Hydrargyri Iodidi	
		— Potassæ	
		— Sodæ Chlorinatæ	

	Approximate Dose.
Liquor Bismuthi et Ammonii Citratis	10—60♏.
— Calcis Saccharatus	
— Ethyl Nitritis	
— Morphinæ Acetatis	
— — Hydrochloridi	
— — Tartratis	

	Approximate Dose.
Liquor Hydrargyri Perchloridi	½—2ʒ.
— Hydrogenii Peroxidi	
— Ammonii Acetatis	2—6ʒ.
— — Citratis	
— Potassii Permanganatis	
— Calcis	1—4℥.
— Magnesii Carbonatis	

Not used internally:

Liquor Acidi Chromici.
— Ammoniæ Fortis.
— Calcis Chlorinatæ.
— Caoutchouc.
— Epispasticus.
— Ferri Perchloridi Fortis.
— — Persulphatis.
— Hamamelidis.
Liquor Hydrargyri Nitratis Acidus.
— Iodi Fortis.
— Pancreatis.
— Picis Carbonis.
— Plumbi Subacetatis Fortis.
— — — Dilutus.
— Sodii Ethylatis.
— Zinci Chloridi.

Liquores (concentrated).—Nearly all these are made by repeated percolation of 10 oz. (2 oz. of Quassia) of the powdered drug with enough Alcohol (20 per cent.) to form one pint of the Liquor. The second percolation usually takes place three days after the first, and those subsequent (commonly ten) at intervals of twelve hours. For Liq. Sarsæ Co. Conc. the Sarsaparilla is infused and the other ingredients are boiled, the decoction is concentrated, and alcohol added to preserve it. Liq. Calumbæ Conc. is made by maceration with water, and Liq. Sennæ Conc. by repeated percolation with water; alcohol is added to preserve both, and that of Senna is flavoured with Tincture of Ginger. There are ten concentrated Liquors, viz.:—

Liquor Calumbæ Concentratus.
— Chiratæ Concentratus.
Liquor Cuspariæ Concentratus

Liquor Krameriæ Concentratus.
— Quassiæ Concentratus.
— Rhei Concentratus.
Liquor Sarsæ Compositus Concentratus.
— Senegæ Concentratus.
— Sennæ Concentratus.
— Serpentariæ Concentratus.

The dose of all Concentrated Liquors is ½—1 fl. dr., except Liq. Sarsæ Co. Conc. 2—8 fl. dr., and Liq. Serpentariæ, ½—2 fl. dr.

Concentrated liquors sufficiently diluted with water may be used as the vehicle in a prescription instead of an infusion or decoction.

Lotiones.—Aqueous mixtures for external use, generally applied on lint, or washed on the part. The B. P. contains two:

Lotio Hydrargyri Flava and Lotio Hydrargyri Nigra.

Mella.—Mixtures of some substance with clarified honey. The B. P. contains only one:

Mel Boracis.

Misturæ.—Liquid preparations consisting of one or more drugs dissolved in water or suspended in a solution of gum or some other thick fluid. The mixture is usually flavoured, and is for internal administration.

Examples in B. P. of solutions: M. Creosoti, M. Sennæ Composita.

Examples in B. P. of suspension: M. Ammoniaci (the gum of which suspends the resin), M. Ferri Co. (triturated with water), M. Cretæ, M. Guaiaci, M. Olei Ricini (suspended in gum).

The dose of all is ½—1℥.

Mucilagines.—Mucilages are aqueous, viscid solutions or partial solutions of gum used for suspending insoluble substances. The B. P. contains two:

Mucilago Acaciæ, and Mucilago Tragacanthæ.

There is no fixed dose; it is usually ʒj.

Olea.—There are many oils in the Pharmacopœia. They are all obtained by distillation or by expression except Oleum Phosphoratum, which is a solution of phosphorus in almond oil. The B. P. olea are—

	Dose.
Oleum Crotonis	½—1♏.
— Anethi	½—3♏.
— Anisi	
— Anthemidis	
— Cajeputi	
— Carui	
— Caryophylli	
— Cinnamomi	
— Coriandri	
— Eucalypti	
— Juniperi	
— Lavandulæ	
— Limonis	
— Menthæ Piperitæ	
— Menthæ Viridis	
— Myristicæ	
— Pimentæ	
— Rosmarini	

	Dose.
Oleum Phosphoratum	1—5♏.
— Copaibæ	5—20♏.
— Cubebæ	
— Santali	
— Terebinthinæ	2—10♏.
— ”	3—4ʒ.
— Morrhuæ	1—6ʒ.
— Ricini	
— Amygdalæ	Not often given internally.
— Cadinum	
— Lini	
— Olivæ	
— Pini	
— Rosæ	
— Sinapis Volatile	
— Theobromatis	

Oxymella.—Oxymels are preparations containing honey and acetic acid. Besides oxymel the B. P. contains only one:

Oxymel Scillæ. *Dose* ½—1ʒ.

Pilulæ.—Solid spherical bodies containing medicinal agents, and intended to be swallowed whole. A mass of the consistence of firm clay is made by beating medicaments together in a mortar. This mass is with a machine divided up and rolled into pills. In order that they may not possess a disagreeable taste, they are often varnished or sugar-coated. Unless the constituents are very heavy, each pill should not exceed 5 grains in weight. Soap, syrup of glucose, and confection of roses are common excipients for pills. Glycerin is sometimes added, for it attracts moisture and prevents the pill from getting hard. Pills may be kept in some powder, as lycopodium, to prevent their sticking together. All purgative pills contain aloes except Pil. Scammonii Co. All pharmacopœial pills are given in doses of about 4 to 8 grains, except—

Pilula Phosphori. *Dose* 1—2 gr.
— Plumbi cum Opio. } *Dose* 2—4 gr.
— Saponis Composita.
— Ferri. *Dose* 5—15 gr.

Pulveres.—Powders are mixtures of finely powdered drugs. The best diluent for powders is sugar of milk, because of its hardness and comparative insolubility. The B. P. contains :

	Approximate Dose.
Pulvis Elaterini Co.	1—4 gr.
— Antimonialis	3—10 gr.
— Opii Co.	
— Ipecacuanhæ Co.	5—20 gr.
— Kino Co.	
— Scammonii Co.	
— Amygdalæ Co.	20—60 gr.
— Catechu Co.	10—60 gr.
— Cinnamomi Co.	

	Approximate Dose.
Pulvis Cretæ Aromaticus	10—60 gr.
— — — cum Opio	
— Jalapæ Co.	
— Rhei Co.	
— Tragacanthæ Co.	
— Glycyrrhizæ Co.	60 to 120 gr.

Pulvis Sodæ Tartaratæ Effervescens (Seidlitz Powder). (See Sodium Compounds.)

Spiritus.—Spirits are either simple or complex. Simple spirits are solutions (which frequently become turbid on the addition of water, owing to the separation of the substance dissolved) in alcohol (90 per cent.) of—

(*a*) A volatile oil :

Spiritus Anisi
— Cajuputi
— Cinnamomi
— Juniperi
Spiritus Lavandulæ
— Menthæ Piperitæ
— Myristicæ
— Rosmarini

The strength of all these is 1 in 10, and the dose 5—20♏., except Sp. Juniperi 1 in 20 and dose 20—60♏.

(*b*) Of camphor :
Spiritus Camphoræ. *Strength* 1 in 10. *Dose* 5—20♏.

(*c*) Of chloroform :
Spiritus Chloroformi. *Strength* 1 in 20. *Dose* 5—40♏.

(*d*) Of ether :
Spiritus Ætheris. *Strength* 1 in 3. *Dose* 20—90♏.

Complex Spirits are of varying composition. They are all prepared by distillation. The B. P. contains five, viz.:

	Dose.		*Dose.*
Spiritus Ætheris Co. — — Nitrosi — Ammoniæ Aromaticus	20–90♏.	Spiritus Ammoniæ Fetidus — Armoraciæ Co.	20–90♏.

Spiritus Rectificatus, and Spiritus Vini Gallici (Brandy), are also pharmacopœial.

Succi.—These are the expressed juices of plants, to which a third of their volume of alcohol (90 per cent.) is added to preserve them. The B. P. contains six:

	Dose.		*Dose.*
Succus Belladonnæ	5—15♏.	Succus Hyoscyami — Scoparii — Taraxaci	½—1½ʒ.
— Conii	½—1½ʒ.		

Succus Limonis contains no alcohol.

Suppositoria.—Suppositories are conical solid bodies containing active drugs for introduction into the rectum or vagina. The basis of all is oil of theobroma, except Sup. Glycerini in which it is gelatin.

The B.P. contains seven, viz. Sup. Acidi Carbolici, Acidi Tannici, Belladonnæ, Glycerini, Morphinæ, Iodoformi, and Plumbi Co.

In hot countries if the Suppositories would otherwise be too soft, some of the Oil of Theobroma may be replaced by White Beeswax.

Syrupi.—Syrups are fluid preparations of drugs flavoured with sugar.

Examples: Sy. Aurantii, Sy. Rhei. The dose of all is about 1ʒ or rather more.

Tabellæ.—Tablets of chocolate, each weighing five grains. The B. P. contains only one:

Tabella Trinitrini (each contains $\frac{1}{100}$ gr. pure nitroglycerin). *Dose* 1—2.

Tincturæ.—Tinctures are solutions of the active principles of drugs in alcohol. They are closely allied to spirits, from which most of them differ in their mode of preparation. They are prepared by—

(*a*) Maceration. The drug is placed in a closed vessel with the whole of the menstruum for seven days, and frequently shaken. It is then strained. The marc is pressed, and the strained and pressed liquids mixed; *e.g.* Tinct. Opii, Tinct. Aloës.

(*b*) Percolation. The drug is moistened with some of the menstruum for twenty-four hours, then the mixture is percolated, more menstruum being added so that a layer of liquid is maintained on the top. The marc is pressed, and the fluid extracted is added to that percolated. After filtration enough menstruum is added to make the prescribed volume of tincture; *e.g.* Tinct. Arnicæ, Tinct. Buchu.

(*c*) Simple mixing or solution of ingredients; *e.g.* Tinct. Chloroformi et Morphinæ Composita, Tinct. Ferri Perchloridi, Tinct. Quininæ.

Tinctures containing only one active substance are simple. The rest are compound; *e.g.* Tinct. Camphoræ Co.

Some are compound although it is not expressed in their name: they are Tincturæ Aloës, Catechu, Kino, Valerianæ Ammoniata, Guaiaci Ammoniata, and Opii Ammoniata.

	Dose.
Tinctura Iodi	2—5m.
— Aconiti	5–15m.
— Belladonnæ	
— Cannabis Indicæ	
— Cantharidis	
— Capsici	
— Chloroformi et Morphinæ Co.	
— Cocci	
— Colchici Seminum	
— Croci	
— Digitalis	
— Ferri Perchloridi	
— Gelsemii	
— Lobeliæ Ætherea	
— Nucis Vomicæ	
— Opii	
— Podophylli	
— Scillæ	
— Stramonii	
— Strophanthi	—2–5m

	Dose.
Tinctura Aloës	30—60m.
— Asafetidæ	
— Aurantii	
— Benzoini Co.	
— Buchu	
— Calumbæ	
— Camphoræ Co.	
— Cardamomi Co.	
— Cascarillæ	
— Catechu	
— Chiratæ	
— Cimicifugæ	
— Cinchonæ	
— — Co.	
— Cinnamomi	
— Conii	
— Cubebæ	
— Ergotæ Ammoniata	
— Gentianæ Co.	
— Guaiaci Ammoniata	
— Hamamelidis	
— Hydrastis	
— Hyoscyami	
— Jaborandi	

	Dose.
Tinctura Jalapæ	30-60 ♏.
— Kino	
— Krameriæ	
— Lavandulæ Co.	
— Limonis	
— Lupuli	
— Myrrhæ	
— Opii Ammoniata	
— Pruni Virginianæ	
— Quassiæ	

	Dose.
Tinctura Quillaiæ	30-60 ♏.
— Quininæ	
— — Ammoniata	
— Rhei Co.	
— Senegæ	
— Sennæ Co.	
— Serpentariæ	
— Sumbul	
— Tolutana	
— Valerianæ Ammoniata	
— Zingiberis	

Tinctura Pyrethri is used as a constituent of mouth washes. Tinctura Arnicæ is used externally.

Tincturæ Opii, Cinchonæ, Cinchonæ Co., Nucis Vomicæ, Belladonnæ and Jalapæ are standardized (*see* p. 7).

Trochisci.—Lozenges or Troches are solid preparations for taking by the mouth. They are made either with a fruit basis, a rose basis, a simple basis, or a tolu basis.

Fruit basis.—Take 500 times the quantity of the drug ordered for one lozenge. Mix it with 15½ ounces of refined sugar and 300 grains of gum acacia. Make the mixture into a paste with 1¼ fluid ounce of mucilage of gum acacia and 2 ounces of the black currant paste of commerce softened with boiling water. Divide into 500 lozenges and dry in hot air chamber; *e.g.* Troch. Acidi Benzoici, Troch. Acidi Tannici.

Rose basis.—These lozenges are made in the same way except that they are flavoured with rose water instead of black currant; *e.g.* Troch. Potassii Chloratis, Troch. Sodii Bicarbonatis.

Simple basis.—These lozenges are made in the same way except that neither rose water nor black currant are used; *e.g.* Troch. Catechu, Troch. Santonini.

Tolu basis.—These lozenges are made in the same way except that Tincture of Tolu is added instead of black currant paste; *e.g.* Troch. Morphinæ, Troch. Acidi Carbolici.

Troch. Sulphuris has a special mode of preparation.

Unguenta.—Ointments are semi-solid preparations consisting of a fatty substance mixed with an active drug. They are spread over the skin, or may be rubbed into it. They are only intended for external use. The basis is either lard, olive oil, wax, spermaceti, paraffin, or hydrous wool fat. Benzoated lard is often used to prevent decomposition. In making Ung. Zinci Oleatis (q.v.) and Ung. Hydrargyri Oleatis (q.v.) a double decomposition occurs between hard soap and metallic salts.

In hot countries if the ointment would otherwise be too soft, the basis may be replaced by indurated lard, prepared suet, yellow beeswax or white beeswax.

Vina.—Wines are weak tinctures, the drug being extracted with sherry in all except Vinum Ferri Citratis and Vinum Quininæ, in which orange wine is used, and Vinum Aurantii, which is merely a fermented saccharine solution to which orange peel is added.

	Dose.		*Dose.*
Vinum Colchici	10—30♏.	Vinum Ferri Citratis	1—4ʒ.
— Ferri	1—4ʒ.	— Quininæ	½—1℥.

With V. Antimoniale and V. Ipecacuanhæ the dose depends upon the purpose for which the drug is used.

V. Ipecacuanhæ is standardized (*see* p. 7).

The following *non-pharmacopœial preparations* are used :

Abstracta.—Powdered extracts double the strength of the crude drug. They are official in the United States Pharmacopœia.

Bougies.—Solid cylinders impregnated with various drugs, and used for introduction into the urethra or nose. They are made either of gelatin (to be dipped in warm water before use) or oil of theobroma (to be dipped in oil before use).

Cachets, made of wafer paper, consist of two watch-glass-shaped halves. The drug is enclosed between them, and they adhere when moistened. The cachet is swallowed, and thus nauseous drugs are not tasted.

Capsules of gelatin are used in the same way as cachets. Pills, cachets, and capsules should be immediately followed by enough water to wash them down.

Cataplasmata.—Soft, pasty external applications made with boiling water having linseed meal as a basis and applied warm (*see* Linseed). An ice poultice consists of crushed ice.

Cerata are ointments containing wax, official in the United States Pharmacopœia.

Cigarettes.—The drug replaces the tobacco of an ordinary cigarette.

Collunaria.—Fluids used as nasal douches,

Collyria.—Fluids used as eye washes.

Cremora.—Creams are preparations having glycerin, vaseline, or some similar substance as a basis, and used for external application.

Elixirs are alcoholic liquids containing various aromatic oils. They are official in the United States Pharmacopœia.

Emulsiones.—Mixtures in which the drug exists as an emulsion.

Enemata (enemas or clysters).—Liquid preparations intended for injection into the rectum. When their object is to empty the bowel they are large in bulk (10 to 20 ℥); when it is wished that they should be retained they are small in bulk (2 to 5 ℥). After injection a towel may be pressed against the anus. Mucilage of starch is a good basis.

Essentiæ (essences).—Solutions of volatile oils in rectified spirit of a strength of 1 in 5.

Fomenta.—Fomentations consist of flannels wrung out in hot water, to which drugs may or may not have been added.

Gargarisma is a fluid preparation used for gargling.

Granules are small pills.

Guttæ.—Fluid preparations to be dropped into the eye.

Haustus.—A draught. This term is used when only a single dose of a fluid preparation is required.

Insufflationes.—Powders for blowing into the throat and larynx.

Lanolinum is an ointment with hydrous wool fat as a basis.

Linctus.—This has honey, treacle, or some other thick substance as a basis. It is to be swallowed slowly, being retained some time in the mouth.

Massæ consist of substances mixed so as to be of a consistency suitable for making pills. They are official in the United States Pharmacopœia.

Mollinum.—A mollinum is an ointment having for its basis mollin, a superfatted soap.

Nebulæ.—Solutions sprayed into the throat by means of an atomizer.

Paste.—A preparation to be applied as an ointment.

Pastillus.—Pastils are lozenges having glyco-gelatin as a basis.

Perles are small pills.

Pessus.—Pessaries are solid preparations made like suppositories, and introduced into the vagina.

Pigmentum.—A paint is a preparation adapted for painting on the skin, throat, &c.

Triturationes are intimate mixtures of substances with sugar of milk. They are official in the United States Pharmacopœia.

Vapores.—Inhalations are preparations arranged for the inhalation of volatile drugs.

Vaselinum.—This term is applied to an ointment the basis of which is vaseline.

PHARMACOLOGY AND THERAPEUTICS.

Before describing the actions and uses of drugs we must consider the manner, quantity, and form in which to give them.

MODES OF ADMINISTRATION OF DRUGS.

(*a*) **Into the blood-vessels** by injection. This method is rarely used in man, except that a saline solution (a teaspoonful of common salt to the pint of water at the temperature of the body) is injected into the veins in cases of great loss of blood.

(*b*) **Into the subcutaneous tissues** by hypodermic injection. The skin of the patient, where it is lax, should be raised between the thumb and forefinger of the operator's left hand; the skin of the forearm is often selected. In his right hand he takes a perfectly clean syringe containing the quantity of fluid to be injected, and fitted with an aseptic hollow silver needle, which is thrust under the raised piece of skin, but not into the muscles, for about an inch, care being taken to avoid wounding a vein. The syringe is slowly emptied, then withdrawn, and the thumb pressed lightly upon the seat of injection for a few seconds. The advantage of this method is that the drug is surely and quickly absorbed. The fluid used must not contain solid particles, nor be irritating, or abscesses will result; it must be aseptic, and therefore if it is not freshly prepared it may contain a little carbolic acid—or, better still, boracic acid, for this is non-poisonous and non-irritating. The bulk injected should, if possible, be about five minims. For injections that are not in constant use it is advisable to keep the drugs in the form of lamellæ, and to dissolve one in a few minims of water as required.

(*c*) **Into serous cavities** by injection. This method is rarely used in man except when the object is to antiseptically wash out a serous cavity, as the pleura, which has been opened, or to produce adhesive inflammation, as in the injection of irritants into the tunica vaginalis.

(*d*) **Into mucous cavities.**—Drugs are most frequently given by the **mouth,** to be absorbed from the mucous membrane of the stomach or intestines, but the rate of absorption is much slower than from the subcutaneous tissue, and will depend upon whether the drug is readily soluble in the gastro-intestinal secretions, and whether it is given on an empty stomach, in which case it will be quickly absorbed ; or on a full one, when it will be slowly absorbed. Some drugs, given by the mouth and absorbed from the stomach or intestines, probably never reach the general circulation, as they are excreted in the bile by the liver. The drug must be in a pleasant palatable form, and generally so combined as not to irritate.

Drugs are sometimes given by the **rectum**—in a solid form as **suppositories**, in a liquid form as **enemata** or clysters; but they are not dissolved nor absorbed here so quickly as in the upper part of the gastro-intestinal canal.

For local effects they may be given by the **urethra** or **vagina (injections, bougies, pessaries)**, or by the **respiratory passages (vapours, cigarettes, sprays**, or **nebulæ** for **inhalations**; **insufflations** for blowing into the throat and larynx; **pigmenta, gargles, lozenges**, for a local effect on the mouth and pharynx; **nasal douches** for the nose). For sprays an atomizer is required. Sometimes volatile drugs, as chloroform or amyl nitrite, are inhaled for their general effect.

(*c*) **By the skin.**—Some drugs may be absorbed from the skin if mixed with some fatty substance. In this way mercury may be absorbed by being rubbed in ; but drugs are chiefly applied to the skin as ointments, plasters, &c., for their local effect.

They are also applied to the **eye** and **ear** as drops and washes.

DOSES.

The study of doses is termed **Posology**. In determining the dose the following considerations have to be borne in mind :

1. Age.—The adult dose is that for a person between twenty and sixty years old.

For **children** under twelve add twelve to the age, and divide the age by the number thus obtained. Thus for a child aged eight the dose will be $\frac{8}{8+12}=\frac{2}{5}$ of an adult dose. From twelve to sixteen years from $\frac{1}{2}$ to $\frac{2}{3}$ of the adult dose is required, and from seventeen to twenty years from $\frac{2}{3}$ to $\frac{4}{5}$. There are exceptions to this rule for individual drugs ; *e.g.* children take iron, cod liver oil, arsenic, and chloral very well, but they can take only very small doses of opium.

Above sixty years of age the dose should slightly diminish as age increases.

2. Weight.—In pharmacological experiments the dose should always be expressed as a proportion of the weight of the animal. In man the weight is not often considered, for it depends so much upon bone and fat, which are not active tissues; but, as a rule, women require rather a smaller dose of medicine than men.

3. Habit.—A man who is constantly under the action of a drug becomes very insusceptible to it. Thus an opium eater requires enormous doses of opium to produce any effect. A person who habitually takes purgatives requires very strong ones to open the bowels.

4. Idiosyncrasy.—The susceptibility to drugs varies very much. Some persons are salivated by minute doses of mercury, others bear it very well, and there is hardly a drug to which some people are not either exceptionally indifferent or susceptible.

5. Time of Administration.—Drugs all act to greatest advantage when given so that their effect will be produced at its natural time. Thus soporifics act best when given in the evening, slowly acting purgatives when given overnight, quickly acting ones when given before breakfast, ergot when given during labour.

6. Mode of Administration.—We have seen that drugs are rapidly absorbed from the subcutaneous tissues. Therefore a smaller dose is required for subcutaneous injection than when the same drug is given by the mouth, for absorption is slow from the upper gastro-intestinal tract. It is slower still from the rectum. Also certain drugs are excreted by the liver or destroyed in it when given by the stomach. Absorption takes place quickly with an empty, slowly with a full stomach.

7. Mental Emotion.—Sometimes if the patient's mind is particularly fixed on the action of the drug a small dose is powerful. For example, often if the patient is convinced he will sleep a very small dose of morphia is all that may be required.

8. Temperature.—As the action of the drug on the organism is often partly chemical, the temperature must, in cold-blooded animals and excised structures, as muscle, &c., help to determine its action; but the temperature of man varies within so few degrees that this is not an important factor in medicine.

9. Preparation of Drug.—A smaller dose of a soluble preparation, as a tincture, will be required than of a solid preparation, as a pill, which will have to be slowly dissolved before absorption.

10. Rate of Excretion.—It is obvious that, other things being equal, a smaller dose will be required of a drug that is slowly excreted than of one which is rapidly excreted.

11. Cumulative Action.—Sometimes it is found that if a person has been taking a drug regularly, but without the production of any toxicological symptoms, these will suddenly develop. This is said to be due to the cumulative action of the drug. It may be caused by the following circumstances:

(*a*) The drug may be absorbed more rapidly than it is excreted. This is the cause of the cumulative action of mercury and lead, both of which are excreted with difficulty by the kidney.

(*b*) There may be a sudden arrest in the excretion of the drug. It is probable that digitalis and strychnine, when the quantity of them in the tissues reaches a certain amount, contract the renal vessels, and hence excretion is arrested.

(*c*) It is possible that, owing to an alteration in the intestinal contents, a drug which was previously very slowly dissolved becomes quickly dissolved, and hence rapidly absorbed.

12. Disease.—The physiological action of drugs, and consequently the dose, are profoundly modified by disease. For example, a patient with peritonitis will bear enormous doses of opium. Antipyretics, which do not affect a normal temperature, powerfully depress a febrile temperature.

PRESCRIBING.

The more complex **prescriptions** consist of—

(1) The Basis, or principal active ingredient.

(2) The Adjuvans, or that which assists its action.

(3) The Corrigens, or that which corrects its operation.

(4) The Constituens, vehicle, or excipient, which imparts an agreeable form.

Thus the object of every prescription is to cure quickly, safely, and pleasantly. For example, in Pilula Colocynthidis et Hyoscyami the colocynth is the basis, the aloes and scammony form the adjuvans, and the extract of hyoscyamus is the corrigens to prevent the griping. In Mistura Cretæ the cinnamon water is the vehicle. Many drugs do not require anything to assist their action or correct their operation.

Incompatibility of ingredients should be particularly avoided in prescriptions. There are three kinds of incompatibility:

(*a*) *Chemical Incompatibility*; *e.g.* glucosides should not be ordered with free acids, which decompose them; nor alkalies, alkaline salts, iodides, or bromides with alkaloids, for they precipitate them.

With the following drugs it is **particularly difficult to avoid chemical incompatibility :**

Chlorine in solution.
Iodine in solution.
Liquid preparations of Iron.
Lead salts.
Zinc salts.
Silver salts.
Mercuric Chloride (especially).
Potassium Iodide.
All other Iodides.
Potassium Permanganate.
Potassium Acetate.
Potassium Bromide.
Tannic Acid.
Gallic Acid.
Acid. Hydrocyanicum Dilutum.
Mineral Acids.
Liquor Potassæ.
Quinine Sulphate.
Guaiacum Tincture.

Substances rich in oxygen, as chlorates, iodates, permanganates, picrates, nitrates, and bichromates, should **not** be mixed **with readily oxidizable substances,** such as charcoal, sulphur, iodine, carbolic acid, glycerin, turpentine, and organic compounds generally, for explosive compounds are very liable to be formed.

Poisonous compounds may be formed by the admixture of substances in solution ; *e.g.* potassium chlorate and the syrup of iodide of iron liberate iodine, dilute hydrocyanic acid and calomel form cyanide of mercury, potassium chlorate and potassium iodide form at the temperature of the body a poisonous compound, probably potassium iodate.

If, in a mixture, incompatibles are inevitable, they should both be diluted with the vehicle before they are added to each other. The careful prescriber will avoid combining any of the above incompatible substances.

(*b*) *Physical Incompatibility.*—This occurs when the mixture of the substances will not form a clear solution ; *e.g.* insoluble powders and oils will not mix with water, the addition of which to some spirits and all resinous tinctures, and to liquid extract of male fern, causes a precipitate ; an acid and quinine mixture is flavoured with liquorice, but the acid precipitates glycyrrhizin ; an alcoholic solution added to chloral causes all the chloral to rise to the top.

In such cases the aqueous solution may be **thickened** so that the precipitate is suspended in it **to form an emulsion,** but even then the mixture must be shaken before a dose is taken. **Mucilage of acacia** is the best emulsifying agent. The substances incompatible with it are mentioned on p. 6. Tragacanth is often preferred, for it keeps better than acacia. The addition of a little almond oil improves its appearance. It is used, for example, to suspend the guaiac resin in Mistura Guaiaci.

The following table, drawn up by Potter, shows the most important instances of solutions which mutually precipitate each other. P *means "forms a precipitate."*

	Alkaloidal solutions.	Metallic solutions (generally).	Lead or silver solutions.	Calcic solutions.	Magnesic solutions.	Albuminous or gelatinous solutions.
Solutions of alkalies	P	P	P	P	P	
Tannic acid	P	P	P	—	—	P
Carbonic acid and solutions of carbonates	P	P	P	P	P	
Sulphuric acid and solutions of sulphates	—	—	P	P		
Phosphoric acid and solutions of phosphates	P	P	P	P	P	
Boric acid and solutions of borates	P	P	P			
Hydrochloric acid and solutions of chlorides	—	—	P			
Hydrobromic acid and solutions of bromides	—	—	P			
Hydriodic acid and solutions of iodides	P	—	P			
Solutions of sulphides	—	P	P			
Arsenical solutions	—	P	P			
Albumen	—	P	P			

Examples of chemical incompatibility are the prescribing of (1) tannic acid or substances containing it with alkaloids or metallic salts, especially those of iron; (2) vinegars or syrups containing acetic acid prescribed with carbonates lead to the evolution of CO_2; (3) strychnine sulphate is decomposed by potassium bromide, and strychnine is precipitated; (4) chloral and alkalies form chloroform; (5) quinine sulphate and potassium acetate together cause a voluminous precipitate of quinine acetate; (6) lime water with mercury salts (this incompatibility is intentional in Lotio Nigra and Lotio Flava) precipitates oxides of mercury; it decomposes carbonates and bicarbonates of alkalies; it precipitates solutions of quinine and morphine salts; (7) mercuric chloride is incompatible with most substances.

1 pt. of most fixed oils	requires M. Acaciæ	¾ pt.,	water	1 pt.
1 pt. of balsam of Peru	,,	2	,,	1½
1 pt. of oil of turpentine	,,	1	,,	1

Sometimes yolk of egg or milk is employed to form an emulsion or suspension. **Liquor Potassæ** much facilitates the admixture of fixed oils and water. This, for example, is the object of the Liquor Potassæ in Mistura Olei Ricini of B. P. 1885. Tincture of quillaia and tincture of senega aid the emulsification of any oil. Light carbonate of magnesium is employed to aid the diffusion of an oil in water, as in Vapor Olei Pini Sylvestris of B. P. 1885. The suspension of oil of turpentine in mucilage of acacia is a very common non-official example of an emulsion.

(*c*) *Pharmacological Incompatibility; e.g.* the combination of purgatives with astringents. Sometimes this is intentional, as in the occasional addition of atropine to a hypodermic solution of morphine. After the description of each drug, those that are incompatible with it will be enumerated.

THE PRESCRIPTION.

The details of a prescription should be written in the following order:

The *first* part is the *Superscription*, which is the sign ℞, an abbreviation for Recipe, " Take."

The *second* part is the *Inscription*, consisting of the names of the drugs in the genitive case (the vehicle in the accusative if " ad " is used with it), and their doses in the accusative.

The *third* part is the *Subscription*, that is to say, the directions to the dispenser. This in England and most other countries is written in Latin, but in France and the United States it is in the native language.

The *fourth* part is the *Signature*, that is to say, the directions to the patient (from L. " Signetur," let it be labelled). This is written in English.

The *fifth* part consists of the doctor's name or initials at the bottom on the right, the patient's name at the bottom on the left, and under it the date; thus:

Superscription.—℞
Inscription.—Tincturæ Ferri Perchloridi ʒiij (basis).
Quininæ Hydrochloridi gr. xxx (adjuvans).
Magnesii Sulphatis (corrigens),
Glycerini, āā ℥ij (corrigens).
Infusum Quassiæ ad ℥viij (excipient).
Subscription.—Fiat mistura.

Signature.—Take one tablespoonful three times a day, two hours after meals. A. B. C. (doctor's initials).
William Smith, Esq. (patient's name).
16th June, 1891 (date).

Abbreviations.—Often this prescription would be abbreviated thus :

℞ Tinct. Fer. Perchlor. ʒiij.
Quin. Hydrochlor. ʒss.
Mag. Sulphat.,
Glycer., āā ℥ij.
Inf. Quas. ad ℥viij.
F. m.

Take one tablespoonful thrice a day, two hours after meals.
William Smith, Esq. A. B. C.
16th June, 1891.

s, ss, and *ſs* are abbreviations for semi, a half, and āā for ana, of each.

The medicine may be prescribed as a **pill** when it is required that the patient shall carry it about with him, when only a small dose is needed, when it is desirable that it shall act slowly, when it is required to act on the lower bowel, when it is insoluble or nauseous, or when it is difficult to prescribe in the liquid form. Kaolin is the best basis for substances, as permanganate of potassium, which are decomposed by contact with organic matter.

Oils, and volatile, deliquescent, or bulky substances should not be prescribed as pills, as they require much solid excipient ; nor should pills be used for substances required to act immediately. Insoluble or very nasty powders are often best given in *cachets*.

Abbreviations should be employed as little as possible. Serious mistakes have happened because the abbreviations have been ambiguous. The following are especially to be avoided :

Acid. Hydroc.	(may be either Acidum Hydrochloricum or Acidum Hydrocyanicum).
Ext. Col.	(„ „ Extractum Colchici or Extractum Colocynthidis).
Hyd. Chlor.	(„ „ Calomel, Corrosive sublimate, or Chloral hydrate).
Hyd.	(„ „ Hydrargyrum, Hydras, Hydriodas, Hydrochloras, Hydrochloridum, or Hydrocyanicus).
Sulph.	(„ „ Sulphur, Sulphide, Sulphate, or Sulphite).

Sometimes the signature is written in Latin, and it is often abbreviated. A list of such abbreviations is given in the appendix.

In Great Britain it is always understood, unless otherwise stated, that the preparations are those of the British Pharmacopœia.

Ad.—The prescriber should be careful in deciding whether or not to use this word before the vehicle. If it had been left out in the prescription just given, the bulk of the mixture would have been nearly 10½ fluid ounces, and the amount of the ingredients in each dose would have been less than was intended.

Dispensing the Prescription.—The dispenser should bear the following rules in mind:—(1) Read the prescription through first. (2) Next write the directions, so that they have time to dry. (3) Solution by heat should not be used if more of the salt is ordered than will dissolve in cold water. In such a case it must be suspended. (4) With fluids, measure them in such an order that the measure-glass shall be finally rinsed out with the vehicle. (5) Use glass scale pans. (6) Clean and put away everything directly after use. (7) If in the slightest doubt ask the prescriber. (8) If finally the prescription contains any insoluble matter, label "Shake the bottle." (9) If the medicine is very poisonous, label it as such and use a distinctive bottle. (10) If for outward application only, say so. (11) In dispensing substances chemically incompatible, if there is any likelihood that the new body formed is dangerous, communicate with the prescriber before dispensing (*e.g.* potassium iodide prescribed with Spiritus Ætheris Nitrosi forms free iodine; alkaloids are precipitated by alkalies). Should there be no such reason against dispensing the prescription, keep the incompatibles as far apart as possible by diluting each with the vehicle before mixing.

PHARMACOLOGICAL AND THERAPEUTICAL ACTIONS.

When the action of a drug is spoken of, the physiological action is usually understood.

The primary action is that due to the unaltered drug; *e.g.* the emetic action of sulphate of zinc.

The secondary action is that due to compounds formed from the drug whilst it is in the body; *e.g.* the antiseptic effect on the urine of Uva Ursi taken by the mouth is probably due to the fact that arbutin, the active principle of Uva Ursi, is in its passage through the kidney decomposed into a glucoside and hydroquinone, and the latter is a powerful antiseptic.

The direct or local action of a drug is that produced on any organ with which it comes in contact; *e.g.* the cantharidin in cantharides, in being excreted through the kidneys, causes inflammation of them.

The indirect or remote action is a secondary effect, the result of the direct effect; *e.g.* urari paralyses the respiratory muscles, consequently the blood becomes venous, and therefore convulsions take place. In this case the venosity of the blood and the convulsions are each of them indirect actions of urari.

It is clear that among drugs acting on the same parts, the total effect will depend very much upon which part is first affected. For example, atropine and urari will paralyse motor nerves, but atropine first affects the terminations of the vagus, and only late in its action the motor nerves of the voluntary and respiratory muscles; hence paralysis and asphyxia are late symptoms, and a rapid pulse is an early symptom. Urari, however, early affects the nerve-endings of the voluntary and respiratory muscles, and the heart towards the end; therefore asphyxia and paralysis occur early, and a rapid pulse is a late symptom.

Relation between Chemical Constitution and Physiological Action.—It is probable that ultimately this relationship will be found to be very close, for certain well-marked instances of it have already been discovered; for example, if strychnine, brucine, and thebaine are converted into methylstrychnine, methylbrucine, and methylthebaine, for the convulsive action of each of the first three substances there is substituted a paralysing action. With regard to the chemical composition, sometimes the base and sometimes the acid appears to determine the action—for example, all salts of arsenic have the same effect; but, on the other hand, the bromides of potassium, sodium, and ammonium are similar to each other in their action. No relationship has yet been made out between the spectroscopic characters, the atomic weights, or the isomorphism of drugs.

Drugs may be classified according to the parts on which they act, and before describing each individual drug, a classification on this principle will be given.

Division I.—Drugs acting upon Organisms which infest the Human Body, or upon Processes going on outside it.

Antiseptics are drugs which arrest putrefaction, either by preventing the growth of, or completely destroying, the micro-organisms on which decomposition depends. Some authors limit the use of the word to those drugs which prevent the growth of micro-organisms, and call those substances which destroy the micro-organisms **disinfectants.**

Statements are most discordant as to whether certain substances are antiseptics, and as to the strength of their antiseptic power. This is because antiseptics act differently on different organisms; and the distinction has not been drawn between preventing the growth of and destroying micro-organisms. Also because the power of antiseptics depends upon the temperature at which they act, the medium in which they are dissolved, the strength of the solution, the time given them to act, and the number of micro-organisms present in the substance to which they are added.

To properly test the value of an antiseptic the above conditions must be noted. All instruments and substances—except the fluid containing the micro-organisms to be tested—are heated so that any adventitious micro-organisms are destroyed. A cultivating medium, such as agar-agar jelly, in which the micro-organisms will grow, is selected, and two test-tubes, each containing some of it, are taken; to one of these the supposed antiseptic is added. Some fluid containing the micro-organisms is then added to both test-tubes; both are plugged with sterilized cotton wool to prevent the entrance of germs from the air, and it is observed whether the micro-organisms will grow in the tube containing no antiseptic, but not in that containing the antiseptic. As the power of an antiseptic depends on so many circumstances, no exact order of their potency can be given, but roughly the more powerful are placed first in the following list; the last are very feeble:

1. **Heat.**—This is the best antiseptic, but a temperature of at least 212° F. is usually required. After an infectious fever, clothing, bedding, &c., may be heated in a dry air chamber to between 200° and 300° F.; or what is far better, as dry air does not penetrate the spores nearly as well as moist, and the interior of the rolls of fabrics often hardly gets heated at all, steam under pressure may be driven through them. Another useful way is to boil the infected things in water. Surgical instruments are disinfected in this way.

2. **Perchloride of Mercury.**—A solution of 1 in 1000 is constantly used for washing hands, and many other purposes connected with midwifery and surgical operations.

3. **Chlorine** is, as a rule, too irritating. Chlorine gas, disengaged by the action of hydrochloric acid on black oxide of manganese, may be used to disinfect a room, the windows, chimneys, and doors of which are pasted up. Disengaged from chlorinated lime, it is used to disinfect urinals. It must be remembered that it attacks and bleaches many substances.

4. **Bromine**, and 5, **Iodine** are rarely used, as they are too irritating.

6. **Naphthol.**

7. **Oleum Eucalypti** has been used in surgery.

8. **Carbolic acid** is largely used.

9. **Quinine**, and 10, **Salicylic acid** are too expensive for ordinary use.

11. **Iodoform** is commonly used to dust wounds, &c.

12. **Boric acid** is used for many surgical purposes.

13. **Chloride of zinc**, and 14, **Permanganate of potassium** are used domestically.

15. **Sulphurous acid**, disengaged by the burning of sulphur, is used to disinfect rooms.

16. **Creosote**, 17, **Benzoin**, 18, **Sulphate of zinc**, 19, **Oxide of iron**, 20, **Lime**, 21, **Thymol**, 22, **Alcohol**, 23, **Balsam of Tolu**, 24, **Balsam of Peru**, are none of them much used.

Creolin, Lysol, Izal and **Formaldehyde (Formalin)** are not pharmacopœial, but they are powerful and much employed.

We do not know of any drugs which, when taken internally or inhaled, will certainly destroy micro-organisms, either in the gastro-intestinal tract or respiratory passages, unless they are sufficiently concentrated to be fatal to the patient. Some authorities, however, consider that naphthol, calomel, and some other substances will destroy many varieties of micro-organisms in the stomach and intestines.

Deodorants or deodorizers are substances which destroy disagreeable smells. There are too many for enumeration. Many antiseptics are deodorizers. Charcoal is often called a disinfectant, but it is merely a deodorizer. It is powerless if it is wet.

Antizymotics.—This is a word sometimes applied to drugs which arrest fermentation.

Anthelmintics are drugs which kill such parasitic worms as infest the alimentary canal. Three kinds only are commonly met with among people living in England.

(1) Tapeworm (*Tænia solium* and *T. mediocanellata*). Anthelmintics: **Filix Mas** (mostly used), **Oleum Terebinthinæ, Cusso, Granati Cortex.**

(2) Round-worm (*Ascaris lumbricoides*). Anthelmintic: **Santonin.**

(3) Thread-worm (*Oxyuris vermicularis*). Anthelmintics: Rectal injections of **salt water, infusion of quassia, solutions of iron salts,** or **diluted oil of turpentine.** It is doubtful whether these drugs (except turpentine) relieve the patient by killing the thread-worms which inhabit the rectum, or merely render this part unfit for them by removal of mucus.

Anthelmintics for the tape- or round-worm should be given when the alimentary tract is empty. Hence it is a good plan to give a dose of castor oil a few hours before the anthelmintic, so as to ensure that the drug comes in contact with the worm. To expel the dead parasite a purgative should be given a few hours after the anthelmintic. Purgatives used for this purpose are called **Vermifuges. Vermicide** is a term sometimes applied to drugs which kill intestinal entozoa.

Antiparasitics or parasiticides are substances which destroy parasites. The term is usually applied to those which destroy parasites infesting the skin.

(1) For the various forms of tinea the following are used:—**Mercurial** preparations, especially the oleate, tincture of **iodine**, glycerin of **carbolic acid**, an ointment of **pyrogallic acid**, a **boric acid** lotion, **salicylic acid** lotion, **acidum sulphurosum**, **formalin**, and **thymol**; and if the patches are small, severe irritants, as **croton oil**, **cantharides**, and **chrysarobin** ointment. *T. versicolor* never requires severe irritants.

(2) As a parasiticide for itch, **sulphur** ointment is generally used. **Balsam of Peru** and **Storax** are also effectual.

(3) Pediculi vestimentorum will be killed by any mild parasiticide. Unguentum **Staphisagriæ** is often used.

(4) Pediculi capitis and pediculi pubis are also easily killed by mild parasiticides; **mercurials** are commonly employed, so is Unguentum **Staphisagriæ**.

Antiperiodics are drugs which arrest the return of diseases which recur periodically. Some, and probably all, act as direct poisons to the micro-organism causing the disease.

They are **cinchona bark**, **quinine** and its salts (by far the most powerful), **cinchonine**, **arsenious acid**, **eucalyptus**, **hydrastis**, **salicin**, and **salicylic acid**. They are used for all forms of intermittent fever and neuralgia.

Division II.—Drugs acting on the Blood.

A. Drugs acting on the Plasma.—Many substances must after absorption exist in solution in the plasma, and purgatives, diuretics, and diaphoretics must alter the composition of the plasma by abstracting substances from it; but when drugs are given with the object of acting on the plasma it is in order to render it more alkaline, for we know no drugs which will make it acid, or even markedly reduce the natural alkalinity of the plasma, as the mineral acids can only exist in it in the form of neutral salts.

The alkalizers of the plasma are salts of—

(1) **Potassium.**
(2) **Sodium.**
(3) **Ammonium.**
(4) **Lithium.**
(5) **Magnesium.**
(6) **Calcium.**

This is approximately the order of their alkalizing power. Potassium is certainly the most powerful. Calcium is very feeble.

The citrates and tartrates of these metals are decomposed in the plasma into alkaline carbonates. An extremely valuable property of alkalizers is the power they have of uniting with **uric acid** in the plasma, and forming urates, which are much more soluble than free uric acid. The **diuretic** effect of the alkali aids the excretion of the urates.

Therapeutics.—The chief use of alkalies is their administration in *gout*, in which disease the uric acid is greatly in excess in the plasma. As the treatment has to be continued for some time, a preparation which does not upset digestion, such as potassium citrate, is usually preferred, or lithium citrate, for the lithium compound of uric acid is said to be the most soluble. For the same purpose natural alkaline waters are frequently prescribed.

In *lead-poisoning* the lead is locked up in the tissues in a very sparingly soluble form. Potassium iodide was given because some authorities believed it increased the solubility of lead in the plasma, and consequently facilitated its excretion by the kidneys.

Alkalies have been largely used in *rheumatic fever*, on the assumption that there is a deleterious agent in the plasma, and that its solubility is increased by increasing the alkalinity of the plasma; but this treatment has now been abandoned in favour of that by salicylates. For the same theoretical reason alkalies have been given in rheumatoid arthritis.

Purgatives, diaphoretics, and *diuretics* necessarily alter the composition of the plasma, and are largely used when there is much œdema of any part, or effusion into serous cavities, in the hope that as fast as these remedies drain off fluid from the plasma it will be replaced by that which is effused pathologically. Also they are given in conditions, as uræmia, in which it is thought that there are poisons in the blood, in order that their excretion may be hastened.

The composition of the plasma can also be altered directly either by venesection or transfusion.

B. Drugs acting on the Red Corpuscles.—The most important are those which can increase the amount of hæmoglobin when that is deficient. Strictly speaking, all these have a pathological and not a physiological action, for we know of no drugs which will increase the amount of iron in perfectly healthy blood. These drugs are called **hæmatinics.**

They are—

(1) **Iron and its salts.**
(2) **Arsenious acid.**
(3) **Potassium permanganate.**
(4) **Salts of copper.**
(5) **Hydrochloric acid** (doubtful).
(6) **Potassium salts** (doubtful).
(7) **Phosphorus** (doubtful).

They not only increase the quantity of hæmoglobin in each corpuscle, but also the number of red corpuscles. Their action is much aided by good food, fresh air, and attention to the general health, and especially to the digestive organs. The mode of action of these hæmatinics is very obscure, and will be discussed under each drug. Iron is by far the most important and effectual.

Indirect hæmatinics are drugs which benefit the patient by removing some obvious cause for his deficiency in hæmoglobin, or anæmia, as it is generally termed. Such are mercury, given for syphilis, quinine for ague, &c.

Alcohol and quinine diminish the oxygenating power of the blood, for they render oxyhæmoglobin a more stable compound than it usually is, but their action in this direction is slight. Citrates and tartrates of the alkaline metals are partially oxidized to carbonates at the expense of the oxygen of the red blood-corpuscles.

The size of the red blood-corpuscles is said to be diminished by carbonic acid, quinine, and morphine, and to be increased by oxygen and hydrocyanic acid, and their number is said to be increased by small doses of mercury.

A large amount of sodium chloride causes the red corpuscles to pass rapidly through the walls of the capillaries.

Quinine and hydrocyanic acid diminish the ozonizing power of the blood.

There are some drugs which are not employed therapeutically for their action on the blood, which are nevertheless very important physiologically and toxicologically, for they kill by **altering the composition of the hæmoglobin**, thus preventing its uniting with oxygen. Such are carbonic oxide, which turns out the oxygen from oxyhæmoglobin, hydrocyanic acid, which forms cyano-hæmoglobin, and potassium chlorate. Acetanilide, phenazone, phenacetin, and nitrites, especially amyl nitrite, convert the hæmoglobin into methæmoglobin; acetanilide, amyl nitrite, and potassium chlorate, like pyrogallic acid, destroy the red corpuscles.

Phosphorus, arsenic, sulphuretted hydrogen, turpentine, iodine, and sulphur also reduce oxyhæmoglobin. Phosphorus is especially destructive to the blood.

When freshly drawn blood is exposed to the air its oxididation is diminished by hydrocyanic acid, alcohol, chloroform, quinine, morphine, nicotine, strychnine, and brucine.

C. Drugs acting on the White Corpuscles.—Most if not all drugs which are poisons to amœbæ are poisons to white corpuscles when applied in sufficient strength, which, however, is rarely the case in the human body. All **irritants** which set up inflammation cause the white blood-corpuscles to wander through the capillary walls; and all the **cinchona alkaloids**, viz. quinine, quinidine, cinchonine, and cinchonidine, have the power of arresting this migration: of these, quinine is the most powerful. **Acetanilide** is also powerful. If the quinine is circulating in the capillaries, it prevents the white corpuscles from wandering out; if it is applied to the outside of the vessels, it prevents the corpuscles from wandering away from the vessel through the wall of which they have passed.

Veratrine applied to white corpuscles outside the body kills them.

Camphor, myrrh and other aromatics increase their production by increasing absorption from the intestine.

The following facts do not fall under any of the previous headings:—Poisonous doses of mercury increase the fluidity of the blood, impair its power of coagulation, and diminish the solids in it. Cod liver oil increases the solids of the blood. Potassium iodide and calcium salts are said to increase its power of coagulation; other substances doing this will be described under astringents.

Division III.—Drugs acting on the Cardiac Mechanism.

The heart is capable of spontaneously originating impulses which in health begin in the sinus venosus, and spread downwards over the auricle and the ventricle to the apex. It used to be considered that these movements were due to spontaneous impulses proceeding from the cardiac ganglia surrounding chiefly the entrance of the superior and inferior venæ cavæ, the entrance of the pulmonary veins, and the auriculo-ventricular groove; but we now know that there is no certain evidence that these ganglia originate impulses, and most of the evidence goes to show that the contraction of the muscular fibres is due to spontaneous impulses arising in them. This contractile power of the muscular fibres can be inhibited by the vagus, the fibres of which proceed from the vagal nucleus in the medulla, and can be augmented by the augmentor or accelerator nerve-fibres, which proceed downwards in the cervical spinal cord to the upper dorsal nerves, from which they pass through the first thoracic ganglion to the sympathetic, and so to the cardiac plexus, and thence to the heart. We are ignorant of any function for the cardiac ganglia ; we know that medullated nerve-fibres lose their medulla in them, and that more fibres proceed from them than enter them. Possibly they have a nutritive function. We have therefore only to consider the action of drugs on the muscular substance of the heart, on the vagal or inhibitory fibres, on the vagal centre, on the augmentor, accelerator, or sympathetic fibres, and on the accelerator centre. The centres are remarkably easily affected by afferent impulses, proceeding from the heart itself or from almost any part of the body. Our information concerning the action of drugs on the heart of man is necessarily rather inexact, for many experiments are difficult to perform upon the mammalian heart, consequently the cold-blooded animals have been largely used ; and as some differences are observed among them—for example, between the frog and the tortoise —it is probable that the deductions drawn from experiments upon the hearts of warm-blooded animals are not wholly applicable to man. In the following account of drugs the action described is that of a moderate dose ; the action of a very large dose is generally the reverse of that of a moderate dose.

A. Drugs acting upon the Heart directly.—Our knowledge of these has been gained by studying the action of drugs upon excised hearts or pieces of the heart, and the action of drugs locally applied to the heart, either by gently applying a solution externally, or internally by means of a perfusion canula. It is difficult to decide whether a drug acts upon the muscular fibre itself, or upon the fine nerves between these fibres, so that no attempt will here be made to distinguish between these actions. As the apex of the heart contains fewer nerves than the rest of the organ, it has been concluded that if a drug acts upon the apex, when it is cut off from the remainder of the heart, it acts upon the muscle only ; but it would be difficult absolutely to deny the existence of fine nerve-fibres in the apex. The vagus or inhibitory nervous mechanism has been much more studied than the accelerating. The effect of stimulating the muscle may be either to increase the rate or the force of the beat, or to do both; that of stimulating the minute branches of the vagus or its terminations in the heart will be either to diminish the rate or the force of the beat, or both; and the effect of stimulating the accelerator fibres will be just the opposite; and in each of these three cases the effect of paralysing will be the reverse of stimulating. The distinction between a stimulating effect on the terminations of the vagus and a depressing effect on the terminations of the accelerator nerves might be determined by observing the effect of stimulation of each of these nerves before and after the local application of the drug, provided that it has been shown that the muscle itself is not affected by the drug; but this is often difficult to prove. It is easily seen that the complexity of the problem is so great that it will be most convenient to classify the drugs which act locally on the heart by the effect they produce, without attempting to say whether they act on the muscle or nerve terminations.

Drugs increasing the force of the contraction :

(1) **Digitalis.**
(2) **Strophanthus.**
(3) **Squill.**
(4) **Saponine.**
(5) **Convallaria Majalis.**
(6) **Caffeine.**
(7) **Veratrine.**
(8) **Erythrophlœum.**
(9) **Barium Salts.**

(In large doses these drugs in frogs always cause arrest of heart in systole; in mammals the final arrest may be in diastole with some, *e.g.* digitalis. **They all slow the pulse.)**

(10) **Dilute solutions of salts of the alkaline metals.**
(11) **,, of copper double salts.**
(12) **Dilute solution of zinc double salts.**
(13) **,, of chloral.**
(14) **Physostigmine.**
(15) **Camphor.**

These drugs have the same action without the final arrest in systole. The rate of the pulse is not markedly altered.

Drugs the chief action of which is to decrease the force of the contraction, usually with stoppage in diastole :

(1) **Dilute acids.**
(2) **Strong solutions of salts of the alkaline metals.**
(3) ,, **of barium salts.**
(4) ,, **of copper double salts.**
(5) ,, **of zinc double salts.**
(6) **Strong solutions of chloral.**
(7) **Muscarine.**
(8) **Pilocarpine.**
(9) **Saponine** (large doses).
(10) **Apomorphine.**
(11) **Emetine.**
(12) **Salicylic acid** (large doses).

Drugs an important action of which is to increase the rate of the cardiac beat :

(1) **Atropine.**
(2) **Hyoscyamine.**
(3) **Daturine.**
(4) **Duboisine.**
(5) **Cocaine.**
(6) **Sparteine.**
(7) **Saponine.**

Drugs an important action of which is to slow the rate of the cardiac beat (see also first list given above) :

(1) **Muscarine.**
(2) **Pilocarpine.**

Drugs which increase both the force and the number of the beats :

(1) **Alcohol.**
(2) **Ether.**
(3) **Chloroform.**
(4) **Anæsthetics.**
(5) **Arsenical salts.**
(6) **Quinine.**
(7) **Strychnine.**

Drugs which decrease both the force and the number of the beats :

(1) **Antimony salts.**
(2) **Aconite.**
(3) **Hydrocyanic acid.**
(4) **Ergot.**
(5) **Veratrine.**

B. Drugs acting on the Vagus Centre.—If we observe that the giving of a drug to an animal alters the beat of the heart, but that this alteration can be done away with, either by cutting the vagi or stimulating the peripheral end of the nerve—if one only of them be cut—we may conclude that the drug acted on the vagus centre in the medulla.

Drugs which stimulate the vagus centre; that is to say, the pulse is slowed, but this slowing disappears on section of the vagi :

(1) **Chloroform.**
(2) **Chloral hydrate.**
(3) **Butyl chloral.**
(4) **Aconite.**
(5) **Veratrine.**
(6) **Nicotine.**
(7) **Digitalis.**
(8) **Strophanthus.**
(9) **Squill.**
(10) **Convallaria Majalis.**
(11) **Hydrocyanic acid.**
(12) **Staphisagria (Delphinine).**
(13) **Atropine.**
(14) **Hyoscyamine.**
(15) **Daturine.**
(These last three only very early in their action.)
(16) **Increased blood-pressure.**
(17) **Venous blood.**

Drugs which depress the vagus centre: Large doses of the drugs mentioned in the last list, and drugs which diminish the blood-pressure, such as amyl nitrite.

C. Drugs acting on the Accelerating Centre.—We do not know anything of drugs which depress this. Some probably stimulate it, for their administration renders the pulse still more rapid after the vagi have been cut.

They are—
(1) **Ammonia.**
(2) **Caffeine.**
(3) **Picrotoxin.**
(4) **Delphinine.**
(5) Any drugs which make the blood venous.

Therapeutics.—The drugs most used for their action on the heart are digitalis, squill, strophanthus, convallaria majalis, caffeine, alcohol, ether, chloroform, strychnine, belladonna, aconite, antimony, and hydrocyanic acid. The therapeutic indication for each of these drugs will be found given under the individual drug.

Division IV.—Drugs acting on the Vessels.

These are usually studied either by directly observing alterations in the size of the vessels in some thin structure, such as the ear of a rabbit, the mesentery, tongue, lung, web, or mylo-hyoid of a frog, or the wing of a bat; or the rate of the flow may be observed. This can be conveniently done by cutting some part, as the toes of a frog, and noticing the rate at which the blood flows from the cut vessels with and without the administration of the drug to the animal. It is often necessary that an artificial circulation should be maintained; for, if not, it might be difficult to prove that the alteration in the quantity of blood flowing from the cut surface was not due to influences acting on the cardiac mechanism. In order to determine if the changes are due to local or central effects, it is necessary to destroy the spinal cord, or to cut the nerves going to the part. When a drug is applied locally, as to the mesentery, and the vessels alter, if the nerves going to the part are not cut, it is difficult to say whether this alteration is direct or reflex.

Drugs are applied to the interior of vessels by injecting them into the circulation.

We know that each vessel is controlled by vaso-constrictor and vaso-dilator nerves, and that these proceed by different paths from the central nervous system, but we do not know by which set of nerves drugs act; probably some by the vaso-constrictor, and some by the vaso-dilator. We can only classify the drugs into those which dilate or contract the vessels by local action, and those which produce these effects through their action on the central nervous system. When a drug acts locally we cannot tell whether it acts on the muscle in the wall of the vessel, or on the nerve terminations.

It of course follows that drugs acting on the heart, or on a large vascular area, will considerably modify the blood-pressure.

A. Drugs acting locally on Vessels.

Drugs which, when locally applied to vessels, dilate them :

(1) **Liquor Ammoniæ.**
(2) **Silver nitrate** (strong).
(3) **Zinc chloride** (strong).
(4) **Copper sulphate** (strong).
(5) **Mercuric nitrate.**
(6) **Arsenious acid.**
(7) **Tartarated antimony.**
(8) **Iodine.**
(9) **Chlorine.**
(10) **Mineral acids** (strong).
(11) **Alcohol.**
(12) **Ether.**
(13) **Chloroform** (the last three if prevented from evaporating).
(14) **Carbolic acid.**
(15) **Creosote.**
(16) **All volatile oils,** as oil of turpentine, and many substances containing them, as mustard, Armoraciæ Radix, &c.
(17) **Senega.**
(18) **Chrysarobin.**
(19) **Ipecacuanha.**
(20) **Capsicum.**
(21) **Croton oil.**
(22) **Camphor.**
(23) **Cantharides.**
(24) **Phosphorus.**
(25) **Warmth,** however applied, but usually as a poultice.

Irritants.—All the above, as they dilate the vessels, are often spoken of as vascular irritants.

Rubefacients are drugs which, when locally applied to the skin, cause it to become red because of the vascular dilatation induced. All the above drugs are rubefacients.

Vesicants.—Many of these drugs are sufficiently powerful irritants to cause inflammation. If this goes no further than the exudation of plasma from the vessels, and this plasma collects under the epidermis to form vesicles, the drug causing the production of vesicles is said to be a vesicant; *e.g.* cantharides.

Pustulants are such of the above drugs as are sufficiently powerful irritants to cause the inflammatory process to proceed to the passage of leucocytes through the walls of the capillaries. They collect in the vesicles, which consequently become pustules; *e.g.* croton oil.

Escharotics or **caustics** are the most powerful of all the above drugs. Their local application kills the part to which they are immediately applied, and sets up vascular dilatation of the surrounding area; *e.g.* strong nitric acid, zinc chloride, silver nitrate, and arsenious acid.

Counter-irritants.—It has been shown by experiments on animals that when the vessels of the skin are dilated by the application of an irritant, those of the subjacent viscera are often reflexly altered in size. The same is probably true of man. An irritant is called a counter-irritant when it is applied to the skin with the object of altering the size of the vessels of the subjacent viscera. It is particularly to be remembered that the action is a reflex nervous one, and is in no way due to the withdrawal of blood into the dilated vessels of the skin.

The following, whether inhaled or taken by the mouth, dilate peripheral vessels by acting locally on them :

(1) **Amyl nitrite.**
(2) **Trinitrin.**
(3) **Sodium nitrite.**
(4) **Ethyl nitrite.**
(5) **Spiritus Ætheris Nitrosi.**

Drugs which, when locally applied to vessels, contract them.

These may act in two ways, either by contracting the muscular coat of the vessels, or by coagulating the albuminous fluids around them, the coagulum by its contraction constricting the vessels.

Those which, applied externally, act on the muscular coat of the vessels :

(1) **Cold,** however produced; hence rapidly volatilizing substances, as ether.
(2) **Lead salts.**
(3) Dilute solutions of **silver salts.**
(4) **Dilute sulphuric acid.**
(5) **Alum.**
(6) **Hamamelis.**
(7) **Acetanilide.**
(8) **Phenazonum.**

All the above, except the last two, are used in medicine to contract vessels. The following have been shown by experiments in the laboratory to cause contraction of small arteries through which they circulate.

Salts of copper, zinc, tin, platinum, barium, all cause powerful contraction.

Salts of lithium, calcium, strontium, magnesium, cadmium, nickel, cobalt, and iron cause slight contraction.

Those which coagulate the albuminous fluids around the vessels :

(1) **Tannic acid** and all substances containing it ; *e.g.* galls, krameria root, kino, hæmatoxylin wood, hamamelis, cinnamon, eucalyptus gum, and catechu.
(2) **Lead** salts.
(3) **Silver** salts.
(4) **Zinc** salts.
(5) **Copper** salts.
(6) **Alum.**
(7) **Per-salts of iron.**
(8) **Bismuth** salts to a slight extent.

B. Drugs which act on the Vaso-motor Centres.

Drugs which, by their action on the vaso-motor centres, dilate the vessels :

(1) **Belladonna.**
(2) **Stramonium.**
(3) **Hyoscyamus.**
(4) **Alcohol.**
(5) **Ether.**
(6) **Chloroform.**
(7) **Chloral.**
(8) **Tartarated Antimony.**
(9) **Aconite.**
(10) **Ipecacuanha.**
(11) **Lobelia.**
(12) **Tobacco.**
(13) **Veratrine.**
(14) **Hydrocyanic acid.**
(15) **Opium** (slightly).

Some of the substances, which in small doses contract the vessels by central action, in large doses dilate them ; viz. digitalis and squill.

Drugs which, by their action on vaso-motor centres, cause contraction of vessels :

(1) **Ergot.**
(2) **Digitalis.**
(3) **Strophanthus.**
(4) **Squill.**
(5) **Hamamelis.**
(6) **Strychnine.**
(7) **Lead salts** (slightly).
(8) **Ammonia** (slightly).

Also, for a very short early period of their action, some substances whose main action is to dilate the vessels by their central action; viz. belladonna, stramonium, hyoscyamus, alcohol, ether, chloroform, hydrocyanic acid, and veratrine.

Astringents are drugs which diminish the size of the vessels, and thus decrease the amount of exudation from them.

Styptics, or **Hæmostatics**, are drugs which stop bleeding. They comprehend **all astringents**, especially cold, lead and copper salts, hamamelis, ergot, tannic acid, and above all per-salts of iron, for they coagulate the blood which is flowing from the vessel, and the clot prevents further bleeding. Matico leaves (B. P. 1885), because of the numerous hairs on their under surface, favour coagulation of blood when locally applied to a bleeding surface. Cobwebs act in the same way.

Therapeutics.—Drugs which locally dilate vessels are continually applied to stimulate sores to heal, and to promote absorption of inflammatory products, as seen in the application of iodine over joints in certain forms of joint disease; and as counter-irritants in many forms of disease of deep-seated organs, as in the application of a blister in pleurisy. Drugs which by their central action cause dilatation of all the vessels of the body are used in certain forms of heart disease, as angina pectoris; and some suppose that the good they do is brought about by dilating the vessels and so rendering the work of the heart easier. Amyl nitrite and nitro-glycerin are much used for this purpose. Drugs causing general vascular dilatation are also employed to cause dilatation of the vessels of the skin, with the object of thereby leading to an increase of perspiration and an increased radiation of heat. Alcohol, Spiritus Ætheris Nitrosi, and Ipecacuanha amongst others are used in this way.

The most important use of astringents is as styptics; they are also used to check excessive discharges of all sorts, as in diarrhœa, leucorrhœa, &c.,

and in relaxed conditions of vessels, such as are often seen in pharyngitis.

There is perhaps no better opportunity than this of mentioning emollients and demulcents.

Emollients are substances which soften and protect parts. The word is usually employed for substances applied to the skin.

Common emollients are substances soaked in warm water, as hot fomentations and poultices, fats of various sorts, as lard and lanolin (hydrous wool fat), non-irritating oils, as olive oil, spermaceti, petroleum, vaseline, &c.

Demulcents are substances which protect and soothe parts. They are generally applied to mucous membranes, especially when unduly dry, and thus they are often used for the mouth.

Instances of them are gelatin, isinglass, glycerin, gum, honey, linseed, starch, and white of egg.

Division V.—Drugs acting on the Skin.

All those described in the last section act on the cutaneous vessels, but in addition we have—

A. Diaphoretics, or drugs which increase the amount of perspiration. These may do so either by stimulating the sweat centres in the spinal cord, the nerves proceeding from the centres to the glands, the terminations of the nerves in the gland, or the glandular cells themselves; or dilatation of the cutaneous vessels may, by the increase in the amount of blood and the greater warmth, stimulate the glands and lead to an increase of sweat. It is difficult to tell whether drugs acting on the vessels do not also act on the other parts of the mechanism; and it is also difficult to decide whether a drug acts on the gland-cells or the terminations of the nerves, so we will consider diaphoretics under two headings, those which act centrally and those which act peripherally. These are differentiated by observing whether the drug acts after the spinal cord is destroyed, and on a part of the skin after the nerves going to it are cut.

(*a*) *Diaphoretics acting peripherally*: **Pilocarpine** greatly increases the amount of sweat, acting in all probability on the nerve terminations in the gland-cells, but certainly not on the vessels. Local applications of **warmth,** and **alcohol** taken internally, perhaps act in the same way in addition to their vascular action.

(*b*) *Diaphoretics acting centrally*:

(1) **Nicotine.**
(2) **Antimony salts.**
(3) **Ammonium acetate.**
(4) **Ammonium citrate.**
(5) **Ipecacuanha.**
(6) **Opium.**
(7) **Camphor.**

(*c*) *Diaphoretics whose mode of action is doubtful*: Senega, cubebs, colchicum, salicine, lobelia, arnica, aconite, **potassium citrate and acetate.** All these, except the last two, are very feeble.

When a diaphoretic acts very powerfully it is called a **Sudorific.**

B. Anhidrotics, or **Antihidrotics,** drugs which diminish the amount of perspiration. The part on which these act is determined in the same way as in the case of diaphoretics.

(*a*) *Anhidrotics acting peripherally*: **Atropine** is very powerful; it acts on the terminations of the nerves in the glands; and **hyoscyamus** and **stramonium** probably act in the same way. The local application of **cold** has a similar action.

(*b*) *Anhidrotics the mode of action of which is doubtful*:

(1) **Acids.**
(2) **Muscarine.**
(3) **Nux vomica.**
(4) **Quinine.**
(5) **Picrotoxin.**
(6) **Zinc salts.**
(7) **Salicylic acid.**

Therapeutics.—Diaphoretics are used for three purposes: either to increase the amount of sweat because that of the urine is failing, and for this purpose pilocarpine is largely used; or in the hope that poisons may be excreted by the sweat, hence the use of pilocarpine in uræmia; or as mild antipyretics, in order to increase the loss of heat by increased evaporation: for this purpose alcohol, ipecacuanha, ammonium acetate, and opium were formerly much employed, but of late years much more efficient antipyretics have been discovered.

Anhidrotics are used either for general conditions, as phthisis, or for local conditions, as sweating of the feet; but they are not of great use in medicine.

We do not know of any drugs which will alter the composition of the sweat, except in so far as that certain drugs may be excreted in the sweat when taken internally: such are iodine, potassium iodide, succinic, tartaric, and benzoic acids, the last in the form of hippuric acid.

We have no knowledge of the effects of drugs on the sebaceous secretion.

Certain drugs when taken internally in large doses **produce a rash** on the skin, possibly because in the course of their excretion through the skin they irritate it. Such are—

(1) **Copaiba.**
(2) **Cubebs.**
(3) **Bromides.**
(4) **Iodides.**
(5) **Turpentine.**
(6) **Belladonna.**
(7) **Chloral.**
(8) **Opium.**
(9) **Quinine.**
(10) **Salicylic acid.**
(11) **Arsenical salts.**
(12) **Acetanilide.**
(13) **Phenazonum.**
(14) **Phenacetin.**
(15) **Chloralamide.**
(16) **Diphtheria Antitoxin.**
(17) **Silver** salts may discolour the skin.

Division VI.—Substances acting on the Urinary System.

1. *Drugs increasing the quantity of urine secreted.* These are called diuretics. The kidney is a double organ with two distinct varieties of epithelium; it is particularly well supplied with vessels and vasomotor nerves, and is also profoundly under the

influence of variations in the blood-pressure; hence it is, with our present state of knowledge, impossible to say how many diuretics act, but the following table (p. 58) from Dr. Lauder Brunton's work shows the various ways in which they probably act, many in more ways than one.

Therapeutics.—Diuretics are used in cardiac and pulmonary diseases when, owing to the general vascular disturbance, the quantity of urine falls below the normal standard. Also in diseases in which there is excess of fluid in certain parts of the body; for example, pleuritic effusion and ascites, with the object of getting rid of as much fluid as possible by the kidneys. Lastly, in certain forms of kidney disease, although in these maladies it is always a question how far it is desirable to stimulate diseased organs. It is of great importance to remember that diuretics may act in many different ways, that there are many causes for diminution in the quantity of urine secreted, and that it is difficult to say in any particular case what is the cause of the decrease in the quantity secreted. Therefore it is usual to give diuretics in combination, in the hope that if one of them does not have the desired result another will.

2. *Drugs diminishing the quantity of urine secreted.*—These are such as produce acute inflammation of the kidney when given in large doses; *e.g.* turpentine, cantharides, phosphorus. They are never given for this purpose in medicine.

3. *Drugs rendering the urine acid.*—There is only one drug that can do this effectually, and that is **benzoic acid**, for in its passage through the kidney it is converted into hippuric acid. Benzoic acid is therefore given when from any cause the urine undergoes alkaline decomposition anywhere within the urinary passages. Salicylic acid will, to a slight extent, increase the acidity of the urine, as will very large doses of citric acid, tartaric acid, citrates and tartrates.

Raise arterial pressure	Generally		Increased cardiac action	**Digitalis,** **Alcohol.**
			General vascular contraction	**Digitalis,** **Strophanthus,** **Squill,** **Convallaria,** **Strychnine,** **Caffeine,** **Cold to skin.**
	Locally in kidney	Contract efferent vessels	Act on vaso-motor centres	**? same as above.**
			Locally on kidney	**Broom,** **Buchu,** **Uva ursi,** **Juniper,** **Turpentine,** **Copaiba,** **Cantharides.**
		Dilate afferent vessels	Either act on vaso-motor centres or locally on renal vessels	**Nitrites,** **Alcohol.**
Act on secreting nerves or renal cells	Increase water excreted			**Urea,** **Caffeine,** **Calomel.**
	Increase water and solids excreted			**Liquor potassæ,** **Potassium acetate,** **Potassium citrate,** **Potassium nitrate,** **Sodium citrate,** **and other salines.**

4. *Drugs which render the urine alkaline.*—All salts of the **metals potassium, sodium, lithium, calcium,** will do this ; even the tartrates, citrates, and acetates, for they escape by the kidney as carbonates. Nitric acid is said to increase the amount of ammonia in the urine, and thus to render it slightly alkaline. Ammonium salts given internally do not render the urine alkaline, because they are decomposed in the body, urea being probably formed.

Lithontriptics are drugs which prevent the deposition in the urinary passages of the solids of the urine. If this fluid be acid, uric acid often crystallizes out, forming gravel or uric acid calculus ; less often calcium oxalate crystallizes, giving rise to calcium oxalate calculus. When there is any likelihood of the formation of either of these calculi, alkalies may be given. If the urine is undergoing alkaline decomposition phosphates are liable to crystallize out. In this case the object will be to render the urine acid and aseptic. This will be attained by giving benzoic acid or benzoates, salicylic acid or salicylates, and urinary antiseptics.

Therapeutics.—The chief use of alkalies is to diminish the acidity of the urine, so as to render the precipitation of uric acid unlikely ; or to render it alkaline, so as to attempt to dissolve a uric acid calculus. We know of no drug which will dissolve an oxalate of lime calculus. Alkalies are also given to gouty subjects, partly to alkalize the blood, but also partly to alkalize the urine, for such persons are very prone to deposit uric acid in the urine. Potassium urate is much more soluble than sodium urate, and lithium urate is perhaps even more soluble ; citrates and acetates are not likely to upset the digestion, consequently the drugs most used are the citrates of potassium and lithium. Copious draughts of water, by diluting the urine, aid in preventing the deposition of uric acid or oxalate of lime calculi. Natural alkaline waters are largely used.

5. *Drugs preventing the urine from decomposing.*—If the urine is retained in the bladder by stricture or from any other cause, it will undergo alkaline decomposition, and the same result may be brought about by the admixture of pus with the urine. This is generally due to inflammation of the pelvis of the kidney or the bladder. This decomposition of the urine may be prevented by giving drugs which in their excretion by the urine render it aseptic. Such are—

(1) **Benzoic acid.**
(2) **Salicylic acid.**
(3) **Uva Ursi.**
(4) **Copaiba.**
(5) **Cubebs.**
(6) **Oil of sanders-wood.**
(7) **Many other volatile oils.**

6. *Drugs altering the composition of the urine.*—Almost any drug will do this, either because it is excreted in the urine, or because it sets up some changes in the body the products of which are excreted in the urine; but here we shall only refer to certain striking ones.

Turpentine, cantharides, and salicylic acid in large doses will cause blood to appear in the urine, because they set up inflammation of the kidney.

Potassium chlorate, all nitrites, acetanilide, pyrogallic acid, poisoning by the mushroom (*Helvella esculenta*), and transfusion of animals' blood, break up red blood-corpuscles, and the products are excreted in the urine, rendering it dark. Large doses of mineral acids, arsenic, and naphthol are said occasionally to produce the same result.

Phosphorus in large doses causes leucine and tyrosine to appear in the urine, and the urea is greatly increased.

The saline diuretics increase the solids of the urine.

The chrysophanic acid in rhubarb and senna makes the urine, if it is acid, a brownish colour; if it is alkaline, a purplish red. Logwood renders alkaline urine reddish or violet. Santonin colours acid urine yellow or greenish yellow, and alkaline urine reddish. Carbolic acid, naphthaline, creosote, and other preparations of tar, as well as the arbutin in uva ursi, make it dark greenish brown. Picric acid makes it a bright yellow, and methyl violet a dark blue.

The urine of persons poisoned with carbonic oxide remains sweet for months.

Poisoning by carbonic oxide, urari, amyl nitrite, and turpentine, and sometimes mercury, morphine, chloral, prussic acid, sulphuric acid, alcohol, lead compounds, and salicylic acid lead to the appearance in the urine of a body which like sugar reduces Fehling's copper solution. In most of these cases this body is not glucose, but glycuronic acid; for although it reduces blue copper solutions, it does not undergo alcoholic fermentation on the addition of yeast, or give the phenylhydrazin test. The administration of phloridzin or phloretin leads to the production of genuine glucose in the urine.

Other drugs cause a peculiar odour in the urine; for example, the smell of violets produced by turpentine. The aromatic odour of cubebs and copaiba can be detected in the urine after the administration of these bodies.

Lead, if taken for long periods, produces chronic interstitial inflammation of the kidney. It is stated that rarely mercury will do the same.

7. *Drugs acting on the bladder and urethra.*—The only ones of any practical value are **sedatives** to the urinary tract.

If the urine is decomposing, drugs preventing its decomposition fall under this head. Other sedatives are **opium, belladonna, hyoscyamus, stramonium, pareira, buchu,** and **uva ursi,** which are direct sedatives to the vesical and urethral mucous membrane. If the urine is excessively acid, alkalies are urinary sedatives.

Urinary sedatives are used very largely in cases of cystitis and urethritis, whatever the cause may be. Local astringent and antiseptic injections are also employed.

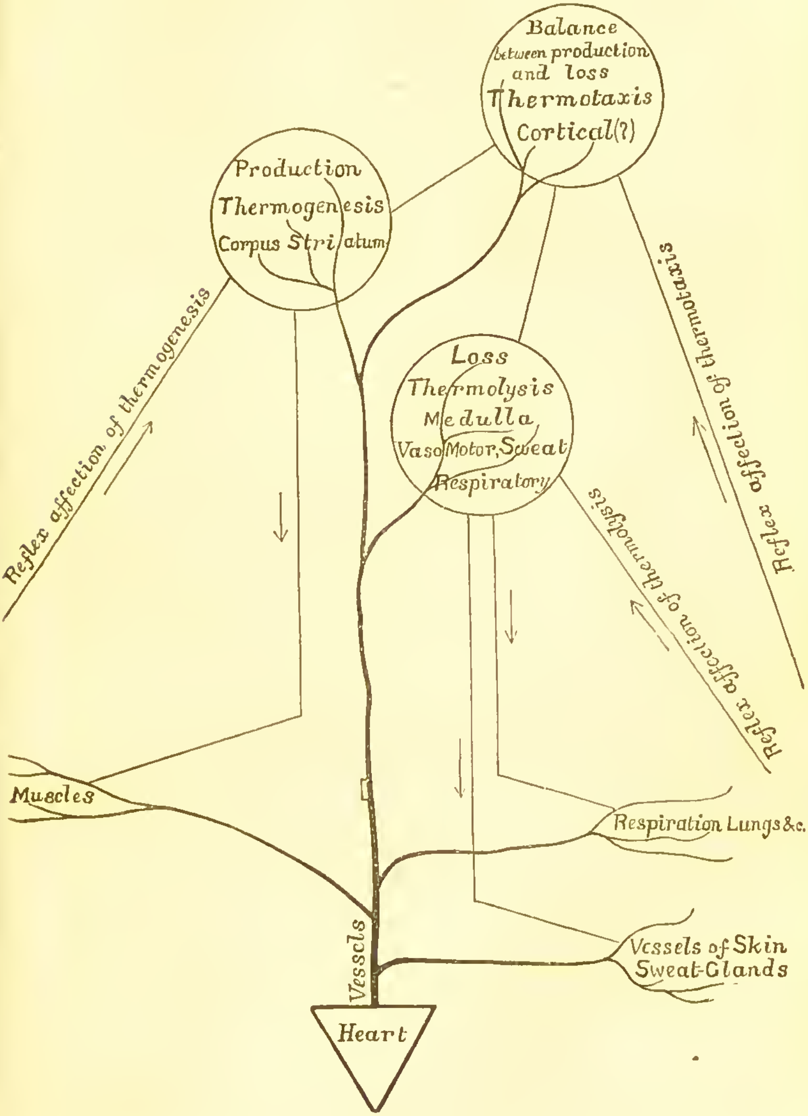
Division VII.—Drugs acting on the Bodily Heat.

A. Antipyretics, or Drugs which decrease the Bodily Temperature.—There are few drugs which can markedly lower the temperature in health. Some, it is true, will cause the temperature to fall below normal if given to a healthy man in large enough doses to induce severe collapse. The word antipyretic is limited to those drugs which bring down the temperature when it is raised owing to disease. We know that the greatest amount of heat is produced in the muscles, and that there is a special part of the corpus striatum presiding over this production; that heat is lost mostly by radiation from the vessels of the skin and by the evaporation of sweat, and that these vessels and the sudoriparous glands are under the control of the central nervous system. Heat is also lost through the lungs. As the production and loss are in health so accurately adjusted, many observers believe that there is a part of the cerebrum whose function it is to maintain the balance between the production and the loss. Also all parts of this complex mechanism are supplied with blood-vessels, alterations in the calibre of which must affect the activity of the parts they supply.

There is every reason for believing that the part of the central nervous system which presides over the loss of heat (thermolysis), that which presides over the production of heat (thermogenesis), and that which possibly presides over the balance between the production and the loss (thermotaxis), can, each of them, be influenced by afferent impulses reaching them from various parts of the body, and thus we see each of these three functions can probably be reflexly affected. (See diagram on opposite page.)

Antipyretics which increase the loss of heat.—All sudorifics and all dilators of the cutaneous vessels act as antipyretics. Cold, such as a cold bath, increases the loss of heat by direct abstraction.

Drugs which probably diminish the production of heat.—Our knowledge about these is at present uncertain, but it is very probable that **phenacetinum**, **phenazonum** (antipyrin), and **acetanilidum**


Balance between production and loss
Thermotaxis
Cortical(?)
Production
Thermogenesis
Corpus Striatum
Loss
Thermolysis
Medulla
Vaso Motor, Sweat
Respiratory
Reflex affection of thermogenesis
Reflex affection of thermotaxis
Reflex affection of thermolysis
Muscles
Respiration Lungs &c.
Vessels of Skin
Sweat-Glands
Vessels
Heart

(antifebrin) diminish the production by their action on the corpus striatum; and that quinine, salicylic acid, and salicin also diminish the production; but we do not know upon what part of the thermogenetic apparatus they act. A cold bath not only abstracts heat, but, after it has been in operation some little time, diminishes the production.

Antimony, aconite, and digitalis are probably antipyretic through their effect on the circulation, but precisely how they act is not known. Sometimes the removal of some irritation which is acting reflexly may lower the temperature. In this way purgatives are occasionally antipyretics.

Therapeutics.—The sole use of antipyretics is to lower the temperature in fever.

Drugs which increase the loss of heat were formerly popular as antipyretics, especially alcohol, nitrous ether, antimony, ipecacuanha, and opium, but now they are not much used. Cold is more often employed, either by cold sponging, ice, or a cold bath. Sponging with hot water will, by the vascular dilatation and subsequent sweating it induces, reduce a febrile temperature.

Of the drugs which alter the production, acetanilide and phenazonum are dangerous because of the collapse they may produce; quinine and salicylic acid are rather uncertain, except in ague and rheumatic fever respectively. Phenazonum and phenacetinum are most in demand. They are certain antipyretics. Phenacetin is very safe, but the less powerful. They are quickly absorbed, and so act promptly; they are far more powerful than any drugs which act by increasing the loss of heat, and these are very uncertain in their action, often not lowering the temperature at all. Another reason for preferring drugs which diminish thermogenesis is that it is more rational to lower temperature by decreasing the production of heat than by increasing the loss, for then the production will, if anything, go on faster, in consequence of the attempt to compensate for the increased loss. Antipyretics should be rarely given, for probably fever is often beneficial.

Drugs which cause a rise of temperature.—Belladonna, picrotoxin and cocaine in poisonous doses may do this, and β-tetrahydronaphthylamine may cause a rise of many degrees in a few hours. How these act is not certainly known.

Tuberculin, various albumoses, and certain animal poisons such as that of shell fish will cause a rise of temperature. Their mode of action is unknown.

We know of no drugs acting on thermotaxis.

Division VIII.—Drugs acting on Respiration.

Respiration can be modified by such very various influences that it is difficult to decide upon the exact mode of action of any drug which affects it. For example, alterations in the blood and in the air will modify it; the respiratory centre itself may be influenced, either directly, or reflexly from almost any organ in the body; or, again, the movements of the respiratory muscles themselves may be interfered with; and, lastly, respiration is much under the influence of the circulatory apparatus. Furthermore, the chief object in medicine is to remove the cause of the respiratory difficulty rather than to act upon respiration itself.

We have already spoken of those drugs which produce changes in the blood and the circulation, and the consideration of those modifications of the temperature, moisture, and pressure of the air which are of value in medicine belongs to a book on general therapeutics. We will therefore now consider the respiratory drugs under the following heads:

A. Drugs altering the Composition of the Air inhaled.—It is found convenient to administer some drugs, although they are not given for their influence on respiration, by making the patient inhale them; such are anæsthetics and amyl nitrite.

Some drugs when inhaled are particularly irritating to the bronchial mucous membrane, causing dilatation of the vessels, increased secretion, and reflexly cough from the stimulation of the sensory nerves of the bronchial mucous membrane.

Such are cold dry air, iodine, bromine, chlorine, senega, ipecacuanha, sulphurous anhydride, nitric acid fumes, ammonia, and tobacco. These are rarely used therapeutically as inhalations, and their inhalation is to be particularly avoided in irritable conditions of the bronchi.

The drugs which, when inhaled, are **soothing** to the bronchial mucous membrane are—

Hydrocyanic acid.
Conium.

These are rarely employed.

Inhalations which are used to **stimulate** the bronchi, that is to say, to increase their vascularity, secretion, and muscular power, are—

Carbolic acid, gr. 20.
Cajeput oil, ♏20.
Creosote, ʒss.
Cubebs oil, ʒss.
Tinctura Benzoini Composita, ʒss.
Vapor Olei Pini Sylvestris (B. P. 1885).

The amounts given after each are the quantities that should be added to a pint of water at 140° F.

Inhalations which are used to **disinfect foul secretions** from the bronchial mucous membrane are those of—

(1) **Creosote.**
(2) **Iodoform.**
(3) **Mild solutions of benzoin.**
(4) **Carbolic acid.**
(5) **Sulphurous anhydride.**
(6) **Oil of juniper.**
(7) **Oil of cubebs.**

Inhalations for **relieving** spasm of the bronchial tubes are those of—

(1) **Conium.**
(2) **Stramonium.**
(3) **Chloroform.**
(4) **Ether.**
(5) **Amyl nitrite.**

B. Drugs acting directly on the Respiratory Centre.—If the drug, when injected into the carotid artery, very quickly produces its effect on respiration, it is concluded that it acts on the respiratory centre. Another experiment, often used to determine whether the drug acts on the centre, or on the vagal terminations in the lung, is to cut the vagi and to observe whether it acts similarly before and after the section.

Drugs which directly **stimulate** the respiratory centre are—

(1) **Strychnine.**
(2) **Ammonia** (very powerful).
(3) **Apomorphine.**
(4) **Belladonna.**
(5) **Stramonium.**
(6) **Hyoscyamus.**

Drugs which **depress** the respiratory centre are—

(1) **Physostigmine** (very powerful).
(2) **Chloral.**
(3) **Chloroform.**
(4) **Ether.**
(5) **Alcohol.**
(6) **Opium.**
(7) **Hydrocyanic acid.**
(8) **Codeine.**
(9) **Virginian Prune.**
(10) **Aconite.**
(11) **Veratrine.**
(12) **Conium.**
(13) **Caffeine.**
(14) **Quinine.**
(15) **Ipecacuanha.**
(16) **Antimony salts** the last very weak).

Alcohol, Ether, Chloroform, Caffeine, and Quinine slightly excite before they depress.

Therapeutics.—The drugs which excite the respiratory centre may be used when there is any difficulty in respiration, especially with the view of increasing the force of the respiratory act whilst other means are employed to get rid of the cause of the difficulty. They are, of course, most frequently required in diseases of the lungs, especially bronchitis. Ammonia and apomorphine are often employed, as they are also powerful expectorants; and belladonna is useful when there is too much secretion from the bronchial tubes.

Substances which depress the respiratory centre are very little needed for this action; but the centre for the reflex act of coughing is in the close neighbourhood of the respiratory centre, and **opium, hydrocyanic acid, codeine, virginian prune, conium,** and **ipecacuanha** are often very valuable in allaying the continual hacking cough which so frequently accompanies disease of the heart and lungs.

The drugs which relieve cough are very numerous, for it may be reflexly set up by irritation of so many peripheral parts, viz. nose, throat, pharynx, ear, teeth, larynx, trachea, bronchi, lungs, pleura, stomach, and liver; and consequently its removal may depend upon the removal of peripheral irritation in any of these organs.

C. Drugs affecting the Bronchial Secretion.

(*a*) *Those increasing it:*

(1) **All alkalies**, especially **carbonate** and other **salts of ammonium.**
(2) **Ipecacuanha.**
(3) **Senega.**
(4) **Squills.**
(5) **Turpentine.**
(6) **Camphor.**
(7) **Benzoin.**
(8) **Balsam of Peru.**
(9) ,, ,, **Tolu.**
(10) **Antimony salts.**
(11) **Sulphur.**
(12) **Iodine.**
(13) **Tobacco.**
(14) **Jaborandi.**
(15) **Many volatile oils.**
(16) **Quillaia.**
(17) **Apomorphine.**
(18) **Terebene.**

(*b*) *Those decreasing it:*

(1) **Acids.**
(2) **Belladonna.**
(3) **Stramonium.**
(4) **Hyoscyamus.**

Many authorities think that under some circumstances alkalies decrease the secretion.

(*c*) *Those disinfecting it.*—Drugs which, when inhaled, act in this way have already been mentioned. Copaiba, cubebs, and many volatile oils are excreted partly by the bronchial mucous membrane, and thus will disinfect the secretion.

Therapeutics.—In bronchitis, remedies which increase the secretion are used when it is so viscid that it sticks to the tubes and cannot be coughed up; and those which decrease it are employed when it is too watery to be easily expectorated. The use of the disinfectants is obvious.

D. Drugs relaxing Spasm of the Muscular Coat of the Bronchial Tubes, or Antispasmodics.—It is believed that in asthma there is a spasmodic contraction of the bronchial tubes, and as

(1) **Stramonium,**
(2) **Belladonna,**
(3) **Hyoscyamus,**
(4) **Grindelia,**

relieve asthma, it is concluded that these drugs relax spasm of the muscular coat of the bronchial tubes. Stramonium is the most powerful. It is very likely, judging by their analogous action in other parts of the body, that the following drugs act in the same way:

Chloroform, Ether, Opium, Chloral, Cannabis indica, Amyl Nitrite, and Conium.

Therapeutics.—Stramonium is of great use in asthma, and this and the other drugs may be employed for cases of bronchitis in which it is probable that the irritation caused by the inflammation of the tubes sets up spasm of them. Many of these muscular depressants in all probability depress the nerves at the same time.

E. Drugs acting on the Vessels of the Bronchi.—These are the same as have been already described (p. 50) as acting on the vascular system generally.

F. Expectorants.—The modes of action of drugs acting on the respiratory system are so complex that it is usual to regard most of them clinically simply as drugs which hinder or aid the expectoration of the contents of the bronchial tubes. Those which aid it are divided into two groups, named after their action, not on the lungs, but on the circulation.

1. *Stimulating expectorants.*—These are stimulants to the circulation generally. They are—

(1) **Acids.**
(2) **Ammonium** salts.
(3) **Senega.**
(4) **Squills.**
(5) **Benzoin.**
(6) **Benzoic acid.**
(7) **Balsam of Tolu.**
(8) **„ „ Peru.**
(9) **Turpentine** preparations.
(10) **Terebene.**
(11) **Oleum Pini.**
(12) **Nux vomica.**
(13) **Sulphur.**
(14) **Quillaia.**

2. *Depressing expectorants.*—These depress the general circulation. They are—

(1) **Alkalies.**
(2) **Antimony salts.**
(3) **Ipecacuanha.**
(4) **Lobelia.**
(5) **Jaborandi.**
(6) **Apomorphine.**
(7) **Potassium iodide.**

Therapeutics.—It is almost impossible to lay down any general directions. The prescriber must consider in any case before him whether he wishes to stimulate or to depress the circulation, to increase or to diminish or to disinfect the expectoration, to stimulate the respiratory centre, to overcome spasm of the bronchial tubes, or to allay a hacking cough ; and he must combine his remedies according to the answer he makes to these questions. Warmth to the chest and warm drinks are sedative, and increase the amount of secretion. Cold and cold drinks have an opposite effect.

G. Drugs which in Man sometimes produce Cheyne Stokes breathing—

These are morphine, potassium bromide, and chloral hydrate. In animals the following in addition may do it : picrotoxin, muscarine, digitalin, strychnine, and ammonium carbonate.

Division IX.—Drugs acting on the Digestive Apparatus.

A. Drugs acting on the Teeth.—Soaps and powders are used for cleaning the teeth. The basis of most tooth powders is chalk, which acts mechanically ;

charcoal is sometimes used in the same way. As the food is very liable to collect and decompose between the teeth, antiseptics, as quinine, borax, and carbolic acid, are often mixed with tooth powders. Astringents, such as rhatany and areca nut, are employed if the gums are too vascular. Mineral acids and alum are injurious to the teeth if used for a long time, and iron is liable to stain them; therefore these substances are best taken through a quill, and should not be used as gargles for long together.

Toothache may be relieved by local anodynes, as creosote, or strong carbolic acid. The tooth is plugged with cotton wool soaked in one of these. Clean cotton wool is placed over the carbolized wool to prevent the acid from reaching the mouth. This method may damage the tooth pulp.

B. Drugs acting on the Salivary Glands.—Much attention has been devoted to the submaxillary gland of the dog, and there is no reason for supposing that the other salivary glands of that animal or of other creatures differ markedly from it. We know that the submaxillary gland is under the influence of the chorda tympani nerve, which contains vaso-dilator fibres, and also some which directly modify the secretion of the gland apart from the secondary effects, due to the alterations in the vessels, obtained when the chorda tympani is stimulated. This nerve has its centre in the medulla, and is capable of being excited reflexly by stimulation of many nerves, even the sciatic, but especially by stimulation of the gastric branches of the vagus, and by the terminations in the tongue and mouth of the glosso-pharyngeal and gustatory nerves. The gland is also supplied with sympathetic branches which proceed from the cervical sympathetic trunk; these are vaso-constrictor, and can also modify the quality of the secretion, but we do not know so much about them as we do about the chorda tympani. Drugs which increase the amount of saliva have been called sialogogues; those which decrease it, antisialogogues. It is clear that there are very many ways in which each of these might act, but here it will suffice to enumerate only those ways in which they are known to act.

1. *Sialogogues acting either on the secretory cells or upon the terminations of the nerves in them.*—Of these jaborandi has been most studied, and, by means of the following experiments, it has been proved to act either on the cells themselves or the terminations of the nerves in them. It acts equally well after section of all the nerves going to the gland. It acts when it is injected directly into the gland but is prevented from reaching the general circulation. If it has been given, stimulation of the chorda or sympathetic produces no more effect on the amount of secretion than can be easily explained by the vascular effects.

Sialogogues falling under this heading are—

(1) **Jaborandi,**
(2) **Muscarine,**
(3) **Compounds of Iodine,**
(4) **Mercury,**
(5) **Tobacco,**
(6) **Physostigmine.**

The last two probably act also by stimulating the centre in the medulla, for section of the chorda tympani decidedly lessens the secretion caused by them. Physostigmine soon ceases to cause an increase of the secretion, for it tightly contracts the vessels of the gland.

2. *Sialogogues acting reflexly by stimulating the peripheral ends of afferent nerves.*—Of these there are two important varieties:

(*a*) Those stimulating the gustatory and glosso-pharyngeal nerves in the mouth:

(1) **All Acids** and
(2) **Acid Salts.**
(3) **Chloroform.**
(4) **Alcohol.**
(5) **Ether.**
(6) **All pungent** substances, as mustard, ginger, &c.

(*b*) Those stimulating the vagus in the stomach:

Most emetics, especially **Antimony** and **Ipecacuanha.**

3. *Antisialogogues acting either on the secreting cells or the terminations of the nerves in them.*—Of these atropine has been most studied, and it is proved to act directly on the gland by the fact that the administration of it prevents any increase of salivary secretion on stimulation of the chorda, although the vessels dilate as usual. It is highly probable that it acts upon the nerve terminations, because even after considerable doses, quite paralysing the secretion of chorda tympani saliva, stimulation of the sympathetic will still induce secretion.

Antisialogogues falling under this heading are—

(1) **Belladonna,**
(2) **Hyoscyamus,**
(3) **Stramonium,** and
(4) **Nicotine** in excess.

4. *Antisialogogues acting reflexly by depressing the peripheral ends of afferent nerves.*—Alkalies, opium, and any substances which allay irritation of the mouth. Part of the effect of opium is due to its depressing action on the medullary centre.

Therapeutics.—A deficiency in the amount of saliva secreted is seen most markedly in fever, when the mouth becomes very dry, and the patient complains of thirst. Sometimes it is a disease in itself, and the origin of this malady is then probably nervous. It is a prominent symptom of belladonna poisoning. In fever, acid drinks, especially those containing carbonic acid gas, lemonade, &c., are of use as sialogogues. Drinks which relieve this febrile thirst are called **Refrigerants.** For the disease known as "dry mouth" jaborandi has been used, and it will relieve the dryness due to belladonna poisoning. Excessive salivary secretion is hardly met with except as a symptom of poisoning, especially by mercury and jaborandi. In some forms of indigestion the saliva has a very unpleasant taste, and may even be diminished in quantity, but then the indication is to treat the indigestion.

C. Drugs acting on the Stomach.—Strictly speaking, we ought to consider these under the following heads :—Those which, by modifying the secretion of hydrochloric acid or pepsin, influence the conversion of proteids into peptones and albumoses. Those which influence the property possessed by the gastric juice of curdling milk. Those which affect its antiseptic power by modifying the secretion of acid. Those which modify the secretion of mucus. Those which influence the nerves, the vessels, or the movements of the stomach. Lastly, those which are emetics. Our knowledge, however, is not sufficient to enable us to do this, and the most useful classification is into those affecting the secretion of gastric juice as a whole, the secreted contents, the vessels, the nerves, the movements, and emetics.

1. *Drugs increasing the amount of gastric juice secreted.*—These are usually called stomachics, and include a great many substances. Stimulants to the mouth reflexly increase the secretion of gastric juice ; all bitter and aromatic substances act in this way, and they also increase the appetite. The mere presence of food in the stomach stimulates the gastric flow. Probably aromatics and bitters act also on the stomach itself.

The drugs which increase the flow of gastric juice are—

(1) **Aromatics.**
(2) **Bitters.**
(3) All **alkalies** (especially potassium and sodium bicarbonates, and Spiritus Ammoniæ Aromaticus).
(4) **Alcohol.**
(5) **Ether.**
(6) **Chloroform.**
(7) **Magnesia.**
(8) **Carbonate of magnesium.**
(9) **Pungent substances** (pepper, mustard, horseradish).

Therapeutics.—Stomachics are very largely used for the purpose of increasing the secretion of gastric juice in cases of dyspepsia.

2. *Drugs decreasing the amount of gastric juice secreted.*

(1) **Mineral** acids. (2) **Acetic** acid. (3) Many of those in the last list if given in large doses, *e.g.* alcohol, ether, chloroform.

Therapeutics.—These drugs are never employed for this effect. It is particularly to be observed that while alkalies increase the secretion of the gastric juice, which is acid, they diminish that of the saliva, which is alkaline; but acids increase the secretion of the alkaline saliva, but diminish that of the acid gastric juice.

3. *Drugs altering the composition of the gastric contents.*—Acids and alkalies naturally modify the reaction of the gastric contents. For this purpose dilute mineral acids are often prescribed to be taken about two hours after a meal, in cases in which the cause of indigestion is thought to be that the amount of hydrochloric acid secreted is deficient. If the acid were given at meal-time it would prevent the secretion of the natural acid; but by giving it after the meal, when all the acid that the gastric juice is capable of forming has been secreted, the drug carries on the act of digestion. In cases of indigestion in which, from the nature of the vomited matters or from any other reason, it is considered that there is an excess of acid in the stomach, alkalies are given at meal-times, the favourite drug being sodium bicarbonate.

Pepsin is given, usually in combination with dilute hydrochloric acid, when it is probable that the cause of the indigestion is the secretion of too small an amount of pepsin; but in this, as in every other variety of dyspepsia, it is far more important to remove the cause of the indigestion than to endeavour to modify the composition of the secreted gastric juice.

Many attempts have been made to try by the administration of **antiseptics** to prevent fermentation and putrefaction from going on in the stomach, but with a limited success, for a sufficient dose is frequently deleterious. Here even more than in the last case the right treatment is to remove the cause of the fermentation or putrefaction.

Drugs that have been used for this purpose are—

(1) **Carbolic acid.**
(2) **Iodoform.**
(3) **Boric acid.**
(4) **Creosote.**
(5) **Eucalyptus.**
(6) **Thymol.**
(7) **Sodium hyposulphite.**
(8) **Sodium sulpho-carbolate.**
(9) **Sulphurous anhydride.**
(10) **Naphthol.**
(11) **Bismuth Salicylate.**
(12) **Salol.**

Charcoal has been employed, but when it is moist it is useless.

4. *Drugs which dilate the vessels of the stomach.*—The vessels of the stomach are very sensitive to irritation. They easily dilate upon mechanical irritation, and the presence of food, especially peptones, causes the vascularity of the mucous membrane to increase. Within limits greater vascularity is an advantage, for it not only favours the secretion of gastric juice, but it facilitates absorption.

The substances which increase the vascularity of the stomach are all stomachics (except alkalies), dilute mineral acids, the drugs which have already been enumerated as irritants generally, and squill, digitalis, colchicum, senega, copaiba, cambogia, guaiacum, and veratrine. This is a very long list, and many of the substances in it are never employed for their irritant effect; in fact, the only ones in common use are the stomachics: the others are far too powerful; even small doses of them set up inflammation of the gastric wall, which is also produced by over-indulgence in stomachics, as we constantly see in the gastritis induced by alcohol. The therapeutic indications for this class of drugs are the same as those for stomachics generally.

Gastro-intestinal irritants.—In describing the individual actions of drugs the statement is frequently made that they are gastro-intestinal irritants, and this is a convenient opportunity for describing the symptoms produced in health by these drugs. If the drug has a caustic action, as many gastro-intestinal irritants have, the swallowing of it will cause considerable pain in the mouth and pharynx, in a short time these parts will become severely inflamed, and consequently very much reddened, swollen, and painful. The tongue will be often much enlarged. If the drug is corrosive, sloughs, generally white in colour at first, with a severely inflamed area around them, will be seen; as they fall off they will leave ulcers. Owing to the pain and swelling, it will for some time be impossible to take any food, or at the best only that of a soft or fluid nature. Directly the drug reaches the stomach intense irritation is set up, consequently the patient feels severe abdominal pain, and generally there is soon violent retching and vomiting. As the poison passes on it produces its severe irritant effects on the intestine, and diarrhœa sets in. Both the vomited matters and the motions often contain blood. The general symptoms are an anxious countenance, small feeble pulse, scanty urine, a low temperature, and all the symptoms of collapse. Later on the gastro-intestinal irritation may be severe enough to set up general peritonitis, or a gastric ulcer may form, and then there may be added to the case all the symptoms of gastric ulcer and its sequelæ. The inflammation of the œsophagus may lead to its contraction. At the post-mortem examination, if the patient has died soon after the administration of the poison, the stomach will be very red and ecchymosed, with a swollen mucous membrane. Parts of the intestine will be in the same condition. This severe inflammation may, in many places, have led to the formation of sloughs. It must be remembered that many gastro-intestinal irritants have no action on the mouth.

5. *Drugs which contract the gastric vessels.*—

These are the same as those which have already been enumerated as being generally astringent. They are much more used for the intestine than the stomach, and will therefore be considered in detail presently (p. 87).

6. *Drugs acting on the nerves of the stomach.*—All drugs powerfully irritant to the stomach cause pain in it; those that are only slightly irritant give rise to a sensation of warmth. It is never desired to produce gastric pain.

Gastric sedatives.—These drugs are the same as those which are local sedatives to other parts of the body. Those most used for the stomach are—

(1) **Bismuth carbonate.**
(2) **Bismuth subnitrate.**
(3) **Bismuth salicylate.**
(4) **Opium.**
(5) **Hydrocyanic acid.**
(6) **Carbonic acid.**
(7) **Ice.**
(8) **Belladonna.**
(9) **Hyoscyamus.**
(10) **Stramonium.**

They are employed in the very many painful forms of dyspepsia. All, except perhaps stramonium, are in frequent use.

7. *Drugs acting on the movements of the stomach.* It has been observed that the movements of the stomach increase as the acidity of the contents increases. If it be that the acidity is the cause of the movements, anything which causes an increase of acidity will lead to more powerful movements. Apart from this, strychnine appears directly to stimulate the plain muscle of the gastric wall. Stomachics also probably aid the movements, so that our complete list will be mineral acids, nux vomica, and stomachics.

The proper churning up of the gastric contents is so necessary, that the value in dyspepsia of drugs which aid the gastric movements is very great. Hence the frequency with which nux vomica enters into antidyspeptic acid mixtures.

Carminatives.—This term is often applied to substances which aid the expulsion of gas from the stomach and intestines. They act by stimulating the gastric and intestinal movements. It has been found from clinical observation that the most efficient carminatives are—

(1) **Stomachics** generally, especially—
(2) **Aromatics,**
(3) **Bitters,**
(4) **Pungent** substances,
(5) **Asafetida,**
(6) **Ammoniacum,**
(7) **Valerian,** and
(8) **Camphor.**

8. *Emetics.*—It is well known that the many complicated mechanisms involved in the act of vomiting are under the control of a centre in the medulla, which is capable of being stimulated by afferent impulses reaching it from many sources, such as the cerebrum, as when sights or smells cause sickness, the mouth, the pharynx, the œsophagus, the lungs, the heart, the stomach, the intestines, the biliary passages, the kidney, the peritoneum, and the uterus ; so that drugs acting on any of these organs, or on the centre itself, might be emetics. But it is usual, in describing drugs which cause vomiting, to mention only those which do so either by acting on the stomach or on the centre in the medulla, and they are divided into two corresponding classes. Those acting on the stomach are sometimes called **direct** emetics, because they act directly on the stomach ; and those influencing the medulla are called **indirect** ; but some authors reserve the word direct for those acting on the medulla, and speak of those affecting the stomach as indirect. Considering this confusion, it is better to divide emetics into gastric and central. By means of the following experiments we determine to which group any drug belongs.

(1) The emetic is injected directly into the circulation. If very shortly after this vomiting takes place, the drug must have acted on the medulla, to

which it has been carried by the circulation ; but if some time elapses we conclude it acted on the stomach, and that it was first excreted into this organ before vomiting took place. This experiment may be made still more striking by injecting directly into the carotid, for then the medulla is quickly reached.

(2) If the least quantity of the drug which, when injected into the circulation, will produce vomiting is larger than is necessary when it is introduced directly into the stomach, the inference is that the drug acts primarily on the stomach, and that when it produces vomiting after injection into the circulation it only does so because some of it has been excreted into the stomach.

(3) If the drug will not produce vomiting after injection into the circulation when the stomach is replaced by a bladder, it shows that it acted on the stomach ; but if vomiting is produced it shows that the drug acted on the medulla, and that the vomiting is caused by the contraction of the abdominal muscles.

(4) If the drug takes a long while to act after its introduction into the stomach, it probably acts centrally ; and the reason for the delay is that sufficient time must elapse for the drug to be absorbed.

In spite of these experiments it is difficult to be sure about the action of emetics, for some act in both ways, and some may in the course of their circulation through the blood act upon some of the many parts of the body from which the vomiting centre receives afferent impulses.

The following is a list of those emetics which are commonly used.

Emetics acting on the stomach :

(1) **Alum.**
(2) **Ammonium carbonate.**
(3) **Copper sulphate.**
(4) **Zinc sulphate.**
(5) **Sodium chloride.**
(6) **Mustard.**
(7) **Warm water.**

Of these zinc sulphate and copper sulphate act slightly on the medulla.

Emetics acting on the medullary centre:

(1) **Apomorphine.**
(2) **Tartar emetic.**
(3) **Ipecacuanha.**
(4) **Senega.**
(5) **Squill.**

Of these tartar emetic and ipecacuanha act partly on the stomach. The first three are very powerful emetics, and are much more depressant in their action than the gastric emetics.

Therapeutics.—Emetics have two uses. Firstly, to remove the contents of the stomach. Thus when that organ is over-full, and there is a feeling of nausea, an emetic by emptying the stomach may relieve. Emetics are largely used to empty the stomach in cases of poisoning, and they may benefit certain cases of sick headache. An emetic occasionally aids the expulsion of a foreign body which has become impacted in the fauces or œsophagus. Secondly, emetics are used to expel the contents of the air-passages, especially in children, for they cannot expectorate well. For this purpose these drugs are given to help children to expel the morbid products in bronchitis, laryngitis, and diphtheria. They also aid the expulsion of foreign bodies that have become impacted in the larynx. In choosing an emetic it will be remembered that although apomorphine, ipecacuanha, and tartar emetic are the most powerful they are the most depressant, and are therefore not suitable in many cases—such, for instance, as poisoning accompanied by severe collapse. When the poison is a powerful gastro-intestinal irritant, if the condition of the mouth and œsophagus will allow of it, it is preferable to wash out the stomach rather than to use an emetic.

Emetics are not permissible for patients suffering from aneurism, hernia, prolapse of the uterus or rectum, peritonitis, or a tendency to hæmorrhage, because of the straining induced by the vomiting, which should make us cautious in giving them to those who have disease of their vessels or high tension in them, for the straining may lead to hæmorrhage.

9. *Antiemetics.*—The causes of vomiting are so numerous that the number of drugs which may stop vomiting is very large; therefore, as in the case of emetics, we can only consider those which act either on the stomach or on the centre in the medulla.

Antiemetics acting on the stomach.—These are all those substances which have been already enumerated as having a sedative influence on the gastric nerves, viz.:

(1) **Ice,** (2) **Bismuth carbonate,** (3) **Bismuth subnitrate,** (4) **Opium,** (5) **Hydrocyanic acid,** (6) **Carbonic acid.** Also some drugs which occasionally appear to have a specific local action in arresting vomiting; such are (7) **Cocaine,** (8) **Cerium oxalate,** (9) minute doses (1♏) of **Vinum Ipecacuanhæ,** (10) minute doses (1♏) of **Tincture of iodine,** (11) minute doses of **Arsenious acid,** (12) small doses of each of **Alcohol,** (13) **Carbolic acid,** (14) **Chloroform,** (15) **Creosote,** (16) **Ether,** (17) **Silver nitrate,** and (18) **Sulphocarbolates.**

Antiemetics acting centrally—

(1) **Opium.** (2) **Bromides of ammonium,** (3) **of potassium,** and (4) **of sodium.** (5) **Chloral hydrate.** (6) **Amyl nitrite.** (7) **Nitro-glycerine.** (8) **Dilute hydrocyanic acid.** (9) **Alcohol.** It will be noticed that some drugs fall under both headings.

Therapeutics.—The very name of these drugs indicates their therapeutical application. At the best they are only palliative; the right way to treat vomiting is, if possible, to remove the cause. Of antiemetics, ice, dilute hydrocyanic acid, carbonic acid, bismuth salts, morphine, and iodine are perhaps the most reliable, but all are very uncertain.

D. Drugs acting on the Intestines.—Many secretions are poured into the intestine, the food is much altered by the time it arrives there, and it is changed in its course down the intestine; the physiology of intestinal digestion, of the movements and the nervous mechanisms of the intestine are imperfectly known; drugs may be considerably altered by the time they come to this part of the alimentary canal, and its diseases are little understood; consequently we cannot arrange the action of drugs in a physiological classification. We know, in fact, of only two important divisions, purgatives and astringents.

The methods of experiment which have been used to determine the mode of action of purgatives are chiefly those of Thiry and Moreau. The first-named observer cut the intestine across in two places a short distance apart: the isolated part which was still attached to the mesentery was sewn up at one end; the other, the open end, was attached to the abdominal wall, and thus there was a test-tube-like piece of intestine into which drugs could be placed. The parts of gut either side of the excised piece were sewn together, so that the whole intestine was the same as before but a little shorter. This method did not give very satisfactory results, and consequently Moreau devised his experiments, which seem more trustworthy. He put four ligatures round the intestine at equal distances apart, so that he shut off from the rest of the gut and from each other three pieces of intestine, each the same length. With a fine syringe he injected into the middle piece the drug to be experimented upon, and returned the whole into the abdominal cavity. In a few hours the animal was killed, and the state of the interior of the middle piece was contrasted with that of the pieces either side of it. Before Moreau's experiments there had been much discussion as to whether some purgatives did not act only by increasing the action of the muscular coat, and others only by stimulating the secretions, but from these experiments it appears that probably the majority act in both ways, some very slightly on the secretion and powerfully on the muscle, and others slightly on the muscle and powerfully on the secretion. We will first consider intestinal purgatives, and then intestinal astringents.

Purgatives are divided into the following classes.

Laxatives.—These are substances which slightly increase the action of the bowels chiefly by stimulating their muscular coat.

They are—
(1) **Whole meal bread.**
(2) **Honey.**
(3) **Treacle.**
(4) **Most fruits,** especially—
(5) **Tamarinds,**
(6) **Figs,**
(7) **Prunes,** and
(8) **Stewed apples.**
(9) **Manna.**
(10) **Cassia.**
(11) **Sulphur.**
(12) **Magnesia.**
(13) **Olive oil.**
(14) **Castor oil** (small doses).

These are all of them domestic remedies employed for slight cases of constipation, especially in children; some, as brown bread, fruits, honey, form articles of diet with persons who are liable to constipation. (15) ergot, (16) physostigma, (17) nux vomica, (18) belladonna, (19) hyoscyamus, and (20) stramonium are also laxatives, but are not used except under medical orders. Nux vomica is most valuable; it is probably a direct stimulant to the muscular coat, hardly influencing secretion. It is largely used in cases of chronic constipation, especially when occurring in anæmic persons, or in those in whom, for any reason, it is likely that the intestinal peristalsis is feeble.

Belladonna in small doses increases peristaltic movements because it paralyses the inhibitory fibres of the splanchnics, but in moderate doses it completely arrests peristaltic movements. It is chiefly employed for this latter purpose, especially in combination with opium. Hyoscyamus acts on the intestines in the same way, and small doses of it are often given with other purgatives to prevent griping, for it gives an orderly rhythm to the irregular contractions the stronger purgatives produce.

Ergot and physostigma are hardly ever used for their laxative effect.

Simple purgatives.—These are rather more powerful in their action than laxatives. They stimulate peristalsis and also increase secretion. Some of the laxatives, as castor oil and magnesia, when given in large doses become simple purgatives.

The simple purgatives are—

(1) **Aloes.**
(2) **Rhubarb.**
(3) **Cascara Sagrada.**
(4) **Senna.**
(5) **Fel Bovinum.**

These are all, except the last two, in common use. The indications for each will be given under the individual drug.

Drastic purgatives, often called cathartics.—These excite greatly increased secretion and peristaltic movements, and if given in large doses cause severe irritation of the intestine with much secretion of mucus, great vascular dilatation and even hæmorrhage, severe abdominal pain and collapse, with profuse diarrhœa. The peristaltic contractions are often irregular, and hence there may be much griping pain; therefore it is usual to prescribe hyoscyamus with these drugs, which are in order of efficiency—

(1) **Calomel.**
(2) **Podophyllum.**
(3) **Aloes.**
(4) **Jalap.**
(5) **Scammony.**
(6) **Gamboge.**
(7) **Oleum Terebinthinæ.**
(8) **Colocynth.**
(9) **Elaterium,** and
(10) **Croton oil.**

The most powerful are placed last. Some, as jalap, elaterium, scammony, are often called **hydragogue,** because of the large amount of secretion they excite.

Therapeutics.—Drastic purgatives are employed in obstinate constipation, and also to produce very watery evacuations with the object of removing as much fluid from the body as possible. Hence the frequent use of jalap in Bright's disease.

Saline purgatives.—The action of these is obscure, but it seems certain that they very greatly increase the secretion of intestinal fluid, and hinder its reabsorption, so that a large amount of it accumulates in the intestine. The distension due to this accumulation excites gentle peristalsis, and consequently an easy painless evacuation of the bowels. Secretion goes on till the fluid in the intestine has become a 5 or 6 per cent. solution of the drug, so that if a very concentrated solution is given, much intestinal fluid is secreted. There is some doubt whether osmosis plays any part in the process. The saline purgatives are—

(1) **Potassium tartrate.**
(2) **Potassium acid tartrate.**
(3) **Potassium sulphate.**
(4) **Sodium sulphate.**
(5) **Sodium tartrate.**
(6) **Sodium citro-tartrate.**
(7) **Sodium phosphate.**
(8) **Sulphate and other salts of magnesium.**

Therapeutics.—These are very largely used as habitual purgatives, especially for persons suffering from any form of gout. They form the essential ingredient of most purgative mineral waters, as Hunyadi János, Pullna, Friedrichshall, Æsculap, Rubinat, &c.

The best way of taking them is to put the required dose of the salt or the mineral water in a tumbler, add some lukewarm water, and sip it slowly while dressing in the morning.

Cholagogue purgatives will be described when speaking of the liver.

Enemata.—Any fluid preparation injected into the rectum is called an enema. When a purgative is liable to produce sickness, or it is unadvisable, because of peritonitis, intestinal obstruction, ulceration, or other disease, to give it by the mouth, it may be given by the rectum. Castor oil, aloes, olive oil, magnesium sulphate, soap, &c., may be administered in this way. Enough of a vehicle must always be used to make a purgative enema up to three quarters of a pint or a pint, for distension of the rectum greatly aids purgation. A teaspoonful of glycerin injected into the rectum, or the same amount given as a suppository, often unlocks the bowels.

Intestinal Astringents.—These may be described under the following heads.

Astringents acting on the vessels of the intestine. These are the same as those acting on vessels generally. Those employed for their action on the intestine are—

(1) **Lead salts.**
(2) Dilute **solutions** of silver salts.
(3) **Alum.**
(4) Dilute **sulphuric acid.**

Astringents coagulating albuminous fluids, and thus constricting the vessels :

(1) **Tannic acid**, and all substances containing it, as—
(2) **Krameria** root,
(3) **Kino,**
(4) **Hæmatoxylin,**
(5) **Cinnamon,**
(6) **Catechu,** and
(7) **Eucalyptus gum.**
(8) **Lead salts,**
(9) **Silver salts,**
(10) **Zinc salts,**
(11) **Bismuth salts,**
(12) **Copper salts,** and especially
(13) **Per-salts of iron.**

Astringents diminishing the amount of intestinal fluid secreted :

(1) **Opium.**
(2) **Lead salts.**
(3) **Calcium salts.**

The precise action of these is obscure, but it is probable that they operate in the way indicated.

Astringents diminishing the contractions of the muscular coat of the intestines :

(1) **Opium.**
(2) **Belladonna.**
(3) **Hyoscyamus.**
(4) **Stramonium.**
(5) **Lead salts.**
(6) **Lime.**
(7) **Bismuth salts.**

Therapeutics.—The first proceeding in every case of diarrhœa is to remove its cause; if this can be done, it will probably subside. Often the cause is some irritating, indigestible food, and then it is advisable to give a mild purge, as castor oil, rhubarb, &c., to get rid of it. The majority of cases of ordinary diarrhœa are probably due to some slight enteritis, and then any one of the astringents that have been named will be valuable, for it is desirable to constrict the dilated vessels, and to diminish the secretion and the movements. Intestinal astringents are therefore often combined, and when the diarrhœa is at all serious opium is of great service. If there is a persistent cause, as tuberculous ulceration, the hope of doing good is slight. But the treatment by drugs is only a small part of the battle: if the diarrhœa is severe, absolute rest is necessary, food must be very simple and given in very small quantities at a time, not much fluid should be drunk, and the patient must keep warm.

Intestinal Antiseptics.—It is very doubtful if it is possible to disinfect the intestinal contents while they are in the body, and if it were possible it might be very harmful, as intestinal micro-organisms greatly help normal intestinal processes. But the attempt is often made. The drugs used are the gastric antiseptics (p. 76) and calomel.

E. Drugs acting on the Liver.—The liver has several distinct functions, viz. to secrete bile, to form and store up glycogen, to form urea, to excrete substances absorbed from the intestine, and to destroy poisonous substances absorbed from the intestine.

1. *Drugs influencing the secretion of bile.*—It does not follow because more bile appears in the fæces that more is secreted, for it may be that the gall-bladder and ducts have been thoroughly emptied, or that the bile which has been poured into the duodenum has been swept along quickly before reabsorption, which is ordinarily brisk, has had time to take place. Drugs which increase the amount of

bile actually secreted are called **direct cholagogues**, or **hepatic stimulants**; but this is a bad name, as the liver has so many distinct functions: those which simply lead to a larger amount of bile being found in the fæces without any extra secretion are called indirect cholagogues.

Direct Cholagogues.—These have been studied in fasting urarised dogs. A canula is inserted into the bile-duct, and is brought out of the body, the drug to be experimented upon is administered, and the amount of bile secreted before and after the administration is noted. No food must be given during the experiment, as that alone causes a considerable increase in the biliary flow.

Direct cholagogues (the most powerful placed first) are—

(1) **Podophyllum.**
(2) **Euonymin.**
(3) **Iridin.**
(4) **Aloes.**
(5) **Ipecacuanha.**
(6) **Dilute nitric acid.**
(7) **Dilute nitro-hydrochloric acid.**
(8) **Mercuric chloride.**
(9) **Sodium phosphate.**
(10) **Sodium salicylate.**
(11) **Sodium benzoate.**
(12) **Sodium sulphate.**
(13) **Colocynth.**
(14) **Colchicum.**
(15) **Potassium sulphate.**
(16) **Ammonium benzoate.**
(17) **Rhubarb.**
(18) **Jalap.**
(19) **Scammony.**
(20) **Dilute arsenious acid.**

There are individual differences among direct cholagogues. Some, as sodium salicylate, make the bile very watery, others, as toluylendiamine, which is not given to man, make it so thick that it flows through the duct with the greatest difficulty.

Indirect Cholagogues.—These cause no increase in the amount of bile secreted; they act by stimulating the upper part of the jejunum and the lower part of the duodenum, thus sweeping the bile on before there is time for it to be reabsorbed.

They are—(1) **Mercury**, (2) most **Cathartic purgatives**, especially **Calomel.**

Therapeutics.—Cholagogues are used for cases of dyspepsia in which there is reason to believe that the liver is the organ at fault, and certainly they often have a very markedly beneficial effect. It is clearly an advantage to combine direct and indirect cholagogues in order to ensure that the bile shall be excreted. As bile itself is a stimulant to the peristaltic movements of the intestine, all cholagogues are purgatives, and form a distinct class of purgatives. In cases of hepatic dyspepsia attention to diet is of the greatest importance, and muscular movements, as riding, rowing, &c., aid in the expulsion of bile from the gall-bladder and ducts.

ANTICHOLAGOGUES.—These are often called hepatic depressants. They decrease the quantity of bile secreted. Calomel, castor oil, gamboge, magnesium sulphate, opium, and lead acetate have this effect, but it is not sufficiently marked to interfere with their therapeutic use for other purposes, and they are never employed for this action.

2. *Drugs modifying the formation of urea by the liver.*—It is believed that some of the nitrogenous substances, especially leucin, arriving at the liver, are there converted into urea. The quantity of urea excreted by the urine is increased by phosphorus, arsenic, antimony, ammonium chloride, and iron. Phosphorus may also lead to the appearance in the urine of leucin and tyrosin. There is some evidence that this drug causes an increase of the urea through its action on the liver, for in phosphorus poisoning that organ undergoes extreme fatty degeneration, and jaundice supervenes. Whether the other drugs act through the liver is doubtful. Antimony and arsenic, if given in large doses for some time, both produce general fatty degeneration. All these substances must be administered in almost poisonous doses in order to increase the urea in the urine, and they are not employed therapeutically for this purpose.

Opium, colchicum, alcohol, and quinine are said to decrease the quantity of urea excreted.

3. *Depressants of the Glycogenic Function.*—**Phosphorus, arsenic,** and **antimony** diminish and even stop the formation of glycogen by the liver ; they also cause fatty degeneration of it. In certain forms of diabetes, **opium, morphine,** and **codeine** have a most marked effect in diminishing the quantity of sugar in the urine.

Division X.—Drugs acting on the Nervous and Muscular Systems.

A. Drugs acting on Muscles.—Pharmacologists have devoted much attention to this class of drugs, but as the facts ascertained are not used in medicine, we need not stop long to consider them. Lauder Brunton gives the following classification, founded on that of Koberts :

Class I. *Irritability of muscle unaffected ; total amount of work it can do diminished.*—The following produce this effect :—Apomorphine, delphine, saponine; copper, zinc, and cadmium. And in large doses antimony, arsenic, platinum, iron.

Class II. *Both the irritability and the capacity for work diminished.*—The following produce this effect :—Potassium, lithium, ammonium, quinine, alcohol, chloral, chloroform.

Class III. *Diminish the capacity for work and make the excitability very irregular.*—Lead, emetine, and cocaine.

Class IV. *Alter the form of the muscle curve.*—Veratrine, salts of barium, strontium, and calcium, digitalis, and squill.

Class V. *Increases the excitability.*—Physostigmine.

Class VI. *Increase the capacity for work.*—Caffeine and theobromine.

Small doses of strychnine and veratrine shorten the latent period ; large doses lengthen it.

Dilute alkalies diminish the extensibility ; dilute acids increase it.

B. Drugs acting on the Peripheral Endings of Motor Nerves.—Of the drugs belonging to this group the action of urari has been worked out most fully. If urari is given to an animal, it is found that the muscles will respond to a mechanical stimulus, although they will not contract when the motor nerve is stimulated. If a single muscle be removed from the circulation by ligature of its vessels before the administration of urari, afterwards it will be the only one that will respond to stimulation of its motor nerve. As this was the only muscle of the body that the drug could not reach, and it is the only one not poisoned, the poison clearly acts locally on the muscles ; but as the urarized muscle will respond to mechanical stimulation urari must paralyse the motor nerves within the muscle, probably the end plates.

Drugs paralysing the termination of the motor nerves in muscle :

(1) Urari,
(2) Conium,
(3) Belladonna (atropine),
(4) Stramonium,
(5) Hyoscyamus,
(6) Saponine,
(7) Sparteine,
(8) Amyl nitrite,
(9) Dilute hydrocyanic acid,
(10) Cocaine,
(11) Camphor,
(12) Lobeline,
(13) Nicotine,
(14) Methyl brucine,
(15) Methyl cinchonine,
(16) Methyl codeine,
(17) Methyl morphine,
(18) Methyl quinine,
(19) Methyl nicotine,
(20) Methyl strychnine,
and many others.

Urari and conium are by far the most important. Therapeutically we never desire to paralyse motor nerve endings.

Drugs stimulating the terminations of motor nerves in muscle :

(1) Aconite.
(2) Nicotine.
(3) Pilocarpine.
(4) Pyridine.
(5) Strychnine (slightly).

Excepting that perhaps some of the beneficial action of strychnine in certain cases may be due to its slight action on motor nerves, we do not employ these drugs for this action.

C. Drugs acting on the Peripheral Endings of Sensory Nerves (other than those of special sense). Our knowledge of these is derived almost entirely from observations on man, for it is very difficult to experiment upon animals, as they have such imperfect means of communicating their sensations to us.

Drugs which stimulate the terminations of sensory nerves.—These, when applied locally, cause pain. They are the same as the local vascular irritants which have already been enumerated (p. 50); in fact, most of them give rise to pain by causing local inflammation. There is no need to repeat the list.

Therapeutics.—Local irritants are chiefly employed for their action on the vessels, but as they are also counter-irritants, their application to the skin, while causing some pain there, will often relieve a deep-seated pain. Although pain is always referred to the periphery, it is appreciated centrally, and therefore peripheral stimulation of nerves, which also reflexly excites the heart and respiration, is used to rouse people from unconsciousness, such as that of fainting, opium poisoning, &c. For these purposes the stimulus must be prompt, hence the application of the faradic current to the skin is a good means to employ.

Drugs which depress the terminations of sensory nerves.—Of these there are two kinds: those which only relieve pain, or **local anodynes**; and those which diminish sensibility, or **local anæsthetics.**

Local Anodynes.—These have no action unless pain be present. They are—

(1) **Aconite.**
(2) **Carbolic acid.**
(3) **Menthol.**
(4) **Dilute hydrocyanic acid.**
(5) **Veratrine.**
(6) **Ether.**
(7) **Alcohol.**
(8) **Chloroform.**
(These last three must be allowed to evaporate.)
(9) **Chloral.**
(10) **Belladonna.**
(11) **Stramonium.**
(12) **Hyoscyamus.**
(13) **Opium.**
(14) **Sodium bicarbonate.**
(15) **Oxide of zinc.**

In the above list the most powerful are placed first. Many other substances are said to be local anodynes, but their claim to the title is doubtful. Cold is a powerful depressant of sensibility, and therefore it is an excellent local anodyne; so also is warmth, for heat dilates the vessels, and thus relieves tension, which is a very powerful factor in causing pain.

Therapeutics.—It is clear that the scope for the employment of local anodynes is very wide. If possible, the first thing is to remove the cause of the pain, but often, as in neuralgia and many forms of pruritus, we cannot do this.

Local Anæsthetics.—These are **cocaine, carbolic acid,** and **extreme cold,** whether produced by ice or the ether spray. This spray was formerly employed to produce local anæsthesia before doing small operations; but it has been superseded by cocaine, which produces a high degree of local insensibility.

D. Drugs acting on the Trunks of Nerves.—These are of greater pathological than pharmacological interest. If taken for a long time they produce chronic inflammation of the nerves, which is shown by the great increase of the fibrous tissue between the nerve-fibres, and the fatty degeneration of the fibres themselves. During the earlier stages the irritation of the nerves causes much pain and tingling; later, as they lose their function, numbness, with loss of sensation, and paralysis set in, often accompanied by trophic lesions. For fuller details books on medicine must be consulted.

The drugs producing peripheral neuritis are—

(1) **Lead.**
(2) **Alcohol.**
(3) **Arsenic.**
(4) **Mercury.**

E. Drugs acting on the Spinal Cord.—The difficulties of experiment are so great that we know nothing of the action of drugs on the sensory portions of the cord. We are also ignorant of the action of drugs on the motor fibres. The following method is adopted to discover whether a drug acts on the cells of the anterior cornua. Suppose we are studying a drug which stimulates the motor cells. After the drug has been given, a slight peripheral stimulus will produce such marked reflex action that convulsions will ensue upon the stimulation. If the cord is cut across and the convulsions follow the stimulus as before, it is clear that these cannot be of cerebral origin, for in that case they would not take place below the point of section. Again, if before injection of the drug into the circulation the vessels of the cord are ligatured, and then the drug causes no convulsion, it is clear that it acts on the cord and not on the muscles or nerves. These results are confirmed if, when the drug is injected into vessels by which it reaches the cord quickly, convulsions occur sooner than when it is thrown into other vessels; also if convulsions do not take place when the cord is destroyed; and lastly if, when the destruction is gradually caused by pushing a wire down the vertebral canal, the convulsions cease from above downwards as the cord is destroyed.

The drugs increasing the irritability of the anterior cornua are—

(1) **Strychnine.**
(2) **Brucine.**
(3) **Ammonia.**
(4) **Thebaine.**
(5) **Chloroform.**
(6) **Ether.**
(7) **Ergot.**
(8) **Opium.**

(The last four only slightly, and early in their action.)

Therapeutics.—It is very rarely that we can do any good in spinal diseases by attempting to stimulate the anterior cornua, but strychnine is occasionally given for cases of paralysis due to disease of the spinal cord.

Drugs which depress the activity of the anterior cornua:

(1) **Physostigmine.**
(2) **Bromides.**
(3) **Alcohol.**
(4) **Chloroform.**
(5) **Ether.**
(6) **Ergot.**
(7) **Opium.**
(8) **Mercury.**
(9) **Zinc salts.**
(10) **Silver salts.**
(11) **Sodium salts.**
(12) **Potassium salts.**
(13) **Lithium salts.**
(14) **Antimony salts.**

(15) **Arsenical salts.**
(16) **Camphor.**
(17) **Amyl nitrite.**
(18) **Sodium nitrite.**
(19) **Chloral.**
(20) **Carbolic acid.**
(21) **Apomorphine.**
(22) **Veratrine.**
(23) **Turpentine.**
(24) **Saponine.**
(25) **Emetine.**
(26) **Gelsemium.**

Of these, apomorphine, alcohol, chloroform, ether, arsenic, camphor, morphine, carbolic acid, chloral, nicotine, and veratrine first excite slightly before depressing.

Therapeutics.—These drugs are of very little use in medicine for their action on the spinal cord. Physostigmine is by far the most powerful, and has been occasionally used in obscure nerve diseases accompanied by convulsions, as tetanus.

Ergot has a very peculiar action in producing sclerosis of the posterior columns of the cord. Lead sometimes causes atrophy of the anterior cornual cells, and long-continued abuse of alcohol probably causes slight degeneration of the cord as a whole.

F. Drugs acting on the Brain.—The action of these cannot be localised nearly so accurately as can that of drugs acting on the spinal cord and nerves. Drugs acting on the brain illustrate two very important general laws.

First, the **law of dissolution,** which, when stated as it applies in pharmacology, is as follows. When a drug affects functions progressively, those first affected are the highest in development; that is to say, they are the last acquired by the individual and the last to appear in the species. The next affected are those next to highest, and so on; till finally the lowest of all from an evolutionary point of view, that is to say, the functions of respiration and circulation, are affected. This law is very well exemplified in the case of alcohol, for the first functions to be disordered are those of the intellect, especially the highest, such as judgment and reason; then follow disorders of movement, and finally death from failure of respiration and circulation.

Another law very well exemplified by drugs which act on the brain is that when a drug in moderate doses excites a function, in large doses it often paralyses it. For example, a person under the influence of chloroform, soon after its administration, tosses his arms about in a disorderly way, but they subsequently become motionless; and many other cerebral stimulants may also be hypnotics.

Drugs acting on the motor centres of the brain.—To investigate these, the motor area of the cortex is exposed by trephining, and the strength of current which it is necessary to apply to the motor area to produce corresponding movements, is noted before and after the administration of the drug. Another method is to observe the strength of current necessary to evoke a movement, then to allow the trephine wound to close, afterwards the animal is made to take the drug regularly for some weeks. The opposite motor area is then exposed, and the strength of current required to call forth movements is noted.

It has been found that

(1) **Alcohol,**
(2) **Anæsthetics,**
(3) **Chloral,**
(4) **Potassium bromide,**
(5) **Sodium bromide,**
(6) **Ammonium bromide,**

diminish the activity of the cells of the motor area.

Bromides are largely used in epilepsy and other convulsive disorders on account of this function.

Drugs exciting the motor cells of the cortex are—

(1) **Atropine.**
2) **Absinthe.**
(3) **Strychnine.**
(4) **Physostigmine.**

They have no therapeutical application in virtue of this property.

General cerebral stimulants.—It is impossible to know anything of these by experiments on animals.

In man they cause general excitation of the mental faculties, followed in many cases by delirium and incoherence. The exact form of delirium differs a little in each case.

Such drugs are—

(1) **Belladonna.**
(2) **Stramonium.**
(3) **Hyoscyamus.**
(4) **Alcohol.**
(5) **Chloroform.**
(6) **Ether.**
(7) **Nitrous oxide.**
(8) **Coffee.**
(9) **Tea.**
(10) **Guarana.**
(11) **Coca.**
(12) **Cannabis indica.**
(13) **Lupulus.**
(14) **Opium.**
(15) **Camphor.**
(16) **Santonin.**
(17) **Quinine.**
(18) **Salicylic acid.**
(19) **Tobacco.**

Therapeutics.—Many of these are taken habitually as cerebral stimulants; for example, alcohol, tea, coffee, tobacco, in England; opium in the East; cannabis indica in many parts of Asia; coca in parts of South America; and if it is wished to give a cerebral stimulant as a drug, one of these is usually chosen. The rest, which are very important, are commonly employed for some other action. With very many of this class of drugs, as will be seen directly, the stimulant action soon gives way to a paralysing influence.

General cerebral depressants.—These are commonly divided into three classes: Hypnotics or Soporifics, Narcotics, Anæsthetics.

HYPNOTICS OR SOPORIFICS are drugs which produce sleep, closely resembling, if not identical with, natural sleep. The brain during sleep is anæmic, and it is thought that this anæmia is the cause of sleep; possibly some soporifics act by producing cerebral anæmia.

The hypnotics are—

(1) **Opium.**
(2) **Morphine.**
(3) **Chloral hydrate.**
(4) **Butyl choral hydrate.**
(5) **Bromides.**

(6) **Chloralamide.**
(7) **Sulphonal.**
(8) **Paraldehyde.**
(9) **Trional.**
(10) **Alcohol.**
(11) **Hyoscine.**
(12) **Cannabis indica.**
(13) **Lupulus.**

Therapeutics.—These drugs are often used for persons suffering from sleeplessness, but it is far more important to remove the cause of the sleeplessness. Sleep is often promoted by dilating the vessels of other parts of the body than the brain; for example, a warm bath or an abundant meal conduces to sleep. The use of hypnotics is greatly abused. Those who take them become habituated to them, so that at last even large doses do not cause sleep. Chloral, the bromides, and chloralamide are perhaps the most satisfactory.

NARCOTICS are substances which not only produce sleep, but also in large doses depress the functions of respiration and circulation. Many of them fall also under the head of general anæsthetics; others are, in smaller doses, hypnotics.

The following is a list of them:

(1) **General anæsthetics.**
(2) **Opium.**
(3) **Chloral hydrate.**
(4) **Belladonna.**
(5) **Stramonium.**
(6) **Hyoscyamus.**
(7) **Alcohol.**
(8) **Cannabis indica.**
(9) **Lupulus.**

All must be given in considerable doses.

Therapeutics.—They are of great use in calming excitement of any kind; many of them, such as, for example, opium and belladonna, are beneficial in relieving distress and producing sleep in heart disease.

GENERAL ANÆSTHETICS.—These are drugs that lead to a total loss of consciousness, so that pain is no longer felt; at the same time reflex action is abolished. They illustrate admirably the law of dissolution, and also the fact that after excitement paralysis often succeeds; and the stages consequent upon these laws can be readily observed in any one who is taking an anæsthetic. Firstly, in obedience to the law of dissolution the highest faculty, the imagination, becomes excited, the patient sees visions and hears noises. He next begins to chatter wildly and incoherently, for in the excitement of any function by a drug the exaltation is usually irregular, and confusion results. Next, the other motor centres of the cortex are stimulated irregularly, so that he gesticulates, throws his arms about wildly, and tosses his body. By this time the brief stimulation of the higher intellectual faculties has probably ceased, and in obedience to the second law vision, hearing, and touch are dulled, and he has lost control over his reason, so that he feels light-headed, as he expresses it, crying and laughing easily; now he is totally irresponsible for his actions and careless as to their results. It will be noticed that the functions are paralysed in the order stated in the law of dissolution. Next there follows upon the stimulation of the motor areas stimulation of the heart and respiration. The pulse and respirations both increase in number, the blood-pressure rises, the face flushes. Then comes depression of all the functions previously excited; first the higher parts of the cerebrum give way, and the patient loses consciousness—neither bright lights, sounds, nor painful impressions rouse him; he becomes quiet, and ceases to throw his arms and legs about; the reflexes disappear, and consequently touching the conjunctiva does not produce closing of the eyelid; the feet do not move when they are tickled, the pupil is contracted, and the previous quickening of the pulse and respiration is succeeded by a slowing of their rate. It is at this period that the patient cannot feel pain, and that therefore operations are performed. The depression of the motor centres is followed by the depression of the muscular tone, and the muscles become quite flaccid and cease to respond to mechanical stimulation. This is the degree of narcosis that is required for the easy reduction of dislocations and for the easy manual examination of the abdominal viscera. Anæsthetics should not be pushed beyond this stage. If they are, even the involuntary muscles lose their tone and reflex excitability, so that the sphincters of the rectum and the bladder relax. The depression of the pulse and respiration continues, the movements of the chest become weaker and weaker and slower and slower, the pulse becomes very feeble, slow, and irregular, and the heart finally stops in diastole. Death occurs partly by the heart and partly by the respiration. At any period of the administration during which recovery is possible, the functions of the body will return in just the reverse order to that in which they were lost, thus again illustrating the law of dissolution. It is often many hours before the mental faculties have recovered their equilibrium, and long after the patient can move his muscles he cannot co-ordinate them. There are individual differences in the different anæsthetics and in different persons.

The general anæsthetics are—

(1) **Chloroform.**
(2) **Ether.**
(3) **Nitrous oxide.**
(4) **Bichloride of methylene.**
(5) **Many other substitution products** derived from alcohols and ethers.

Therapeutics.—Anæsthetics are given to cause unconsciousness, so that pain may not be experienced during operations, to relax muscles in cases of dislocations, abdominal examinations, phantom tumours, &c., to relieve severe pain, such as that of parturition, biliary and renal colic, to quiet the body during convulsions, as in tetanus and hydrophobia.

The chief dangers of anæsthetics are—1. Death from shock. This usually takes place before the patient is fully under the influence of the anæsthetic, reflex action is not yet quite abolished, and the heart is stopped reflexly from the peripheral stimulus of the operation. This is one of the greatest and most common dangers of anæsthetics, especially chloroform. It is, to a large extent, avoidable if care be taken that the patient is fully under the influence of the anæsthetic before the operation is begun ; often when it is trivial the operator is in too great a hurry to begin, and the patient suddenly dies from failure of the heart.

2. Death from paralysis of respiration. This is usually due to a combination of circumstances. Too much of the anæsthetic may have been given, respiration may be difficult because the patient suffers from some disease of the lungs, or the operation may demand that he should lie on his side or in some other position which hampers respiration. It is not a very great danger, for it is heralded by lividity ; and if then the posture is changed, the administration of the anæsthetic is stopped, and artificial respiration is performed, the patient usually quickly recovers ; even if he does not, artificial respiration with the head thrown back and the tongue pulled out should be carried on as long as there is any evidence that the heart is beating, or if the patient draws a breath when artificial respiration is stopped for half a minute. Cases have recovered although it has been necessary to keep up artificial respiration for hours.

3. Cardiac failure may occur if the vapour is too concentrated. The patient almost suddenly becomes pale, and the pulse stops. In such a case no more anæsthetic must be given, artificial respiration must be kept up in the manner just mentioned, and the heart may be stimulated by the subcutaneous injec-

tion of brandy, by the inhalation of amyl nitrite, by the application of the faradic current over the cardiac region, by the plunging of electric needles into the heart, or by flicking the chest over the heart with hot towels and placing hot compresses over it. The feet should be raised and the head depressed.

4. Vomited matter and, if the operation is about the mouth, blood may suffocate the patient. To avoid the first contingency no food should be taken for some time before the operation, and if the patient is sick he should be turned on his side; to avoid the latter special precautions must be taken, which are described in books on operative surgery.

For the relative advantages of the different anæsthetics and the mode of giving each, the account of the individual drugs must be consulted.

G. Drugs acting on the Eye.

1. **Drugs acting on the Pupil.**—The first thing to determine is whether any drug which dilates or contracts the pupil acts locally or centrally. It is dropped into one eye: if it only acts feebly and after some time and on both eyes, it follows that it has acted centrally after absorption from the conjunctiva into the general circulation; but if it acts quickly, powerfully, and only on the eye into which it was dropped, its action is local. If it acts on an excised eye its action must be local. If, when all the vessels going to the eye are ligatured, the drug will act when dropped into the eye, but will not when thrown into the general circulation, this again shows that its action is local, and that when it acts after being thrown into the circulation when no vessels are ligatured it does so because it is circulating locally through the eye. If all the arteries and veins of the eye are ligatured, and the drug will not act when locally applied, although it would before, and will

now when thrown into the general circulation, it shows that its action is central, and that it acts when dropped into the eye because some of it is absorbed.

If it has been proved by these means to act centrally the further investigation is difficult, for the central mechanism is complex.

If it has been proved to act locally, it may act either on the muscular fibres of the iris, on the terminations of the third nerve in them, or on the terminations of the cervical sympathetic in them. Stimulation of the third nerve causes the pupil to contract; section of it causes the pupil to dilate. Stimulation of the sympathetic causes the pupil to dilate; section of it causes the pupil to contract. If the pupil is dilated by the local action of a drug, and stimulation of the third nerve will not cause it to contract, but yet the muscle is responsive to mechanical stimulation, it shows that the endings of the third nerve are paralysed. If the pupil is contracted by the drug, and although responsive to mechanical stimulation, will not dilate when the third nerve is cut, it shows that the ends of the third nerve are stimulated. If a drug locally dilates the pupil, but not as powerfully as stimulation of the sympathetic, it is clear that its whole effect is not due to a stimulation of the sympathetic; and if the muscle remains locally irritable, the third nerve ending must be paralysed. A series of similar experiments may be made with regard to the sympathetic. By these means the mode of action of many drugs has been made out, but often they act both on the sympathetic and the third nerve. In the following list they will be classified under their main actions.

Mydriatics (*pupil dilators*)—

A. Paralyse the terminations of the third nerve.

(1) **Atropine.**
(2) **Homatropine.**
(3) **Daturine.**
(4) **Hyoscyamine.**

(5) **Conine.**
(6) **Gelsemine.**
(7) **Muscarine.**
(8) **Hydrocyanic acid.**
(9) **Aconite.**
(10) **Amyl nitrite.**

It is not quite certain how the last five act, but probably on he ends of the third nerve.

B. Stimulate the terminations of the sympathetic.—**Cocaine.**

C. Act centrally.—**Anæsthetics** (late in their action).

Myotics (*contract the pupil*).

A. Stimulate the terminations of the third nerve.—**Pilocarpine, nicotine** (probably).

B. Stimulate the muscle.—**Physostigmine.**

C. Act centrally.—**Anæsthetics** (early in their action), **opium.**

Therapeutics.—Dilators of the pupils, especially atropine and homatropine, are used to dilate the pupil for ophthalmoscopic examination, and to prevent or break down adhesions of the iris. Contractors of the pupil, especially physostigmine, are used to overcome the effects of atropine, and to prevent too much light entering the eye in painful diseases of it.

2. **Drugs acting on the Ciliary Muscle.**—The following drugs impair or paralyse accommodation :

(1) **Atropine.**
(2) **Daturine.**
(3) **Hyoscyamine.**
(4) **Homatropine.**
(5) **Cocaine.**
(6) **Phyostigmine.**
(7) **Pilocarpine.**
(8) **Gelsemine.**
(9) **Conine.**

Intra-ocular tension is increased by atropine (large doses), hyoscyamine, daturine. It is decreased by cocaine and physostigmine.

Gelsemine paralyses the external ocular muscles, especially the levator palpebræ and the external rectus, by its action on the terminal nerve filaments.

Cocaine stimulating the unstriped fibres in the orbital membrane and the eyelids causes the eye to protrude.

Conine produces ptosis,

The capacity for seeing blue is increased by strychnine. Santonine causes first violet, then yellow vision.

H. Drugs acting on the Ears.—We know very little about the action of drugs on these. Quinine and salicylic acid cause noises and buzzing.

J. Drugs acting on Sympathetic System.—Much of this subject has already been discussed when speaking of the action of drugs on vessels. The curious fact has been made out that if an animal be treated with a large dose of nicotine, or if this be applied locally to the superior cervical ganglion, stimulation of the nerve below the ganglion no longer produces its characteristic effects, although stimulation above the ganglion does.

Division XI.—Drugs acting on the Organs of Generation.

A. Aphrodisiacs.—These are substances which increase sexual desire. There are conceivably many ways in which this might take place. There is a centre in the lumbar spinal cord, irritation of which causes erection, and this is capable of being excited by afferent impulses proceeding from many parts of the body, but especially from the cerebrum, and the genital organs themselves, or the parts in their immediate neighbourhood. The lumbar centre appears to be very dependent upon the general health, and therefore substances which improve this are indirectly aphrodisiacs.

The following drugs have been used as aphrodisiacs; their mode of action is not certainly known.

(1) **Strychnine.**
(2) **Cantharides.**
(3) **Alcohol.**
(4) **Cannabis indica.**
(5) **Camphor.**
(6) **Phosphorus.**
(7) **Damiana.**

B. Anaphrodisiacs.—We do not know for certain of any drugs which have a depressant effect upon the lumbar centre. Most anaphrodisiacs act by decreasing or removing some irritation which is reflexly producing an aphrodisiac effect, but some probably act centrally.

Drugs used as anaphrodisiacs are—

(1) **Bromides.**
(2) **Iodides.**
(3) **Opium.**
(4) **Belladonna.**
(5) **Hyoscyamus.**
(6) **Stramonium.**
(7) **Digitalis.**
(8) **Purgatives.**

C. Ecbolics or **Oxytocics** are remedies which during or immediately after parturition increase uterine action.

They are—

(1) **Ergot.**
(2) **Quinine.**
(3) **Savin** (B. P. 1885).
(4) **Hydrastis.**
(5) **Rue** (B. P. 1885).
(6) **Powerful purgatives.**

Of these ergot is by far the most important. Occasionally some of these drugs will act upon the gravid uterus to produce abortion before parturition has begun. They have all of them been used criminally for this purpose.

D. Emmenagogues are substances used to increase the menstrual flow. Diminution of the menstrual flow is a symptom of so many diseases that a large number of drugs which remedy these are indirect emmenagogues, but the substances which seem to have a special action in increasing the menstrual flow are—

(1) **All Ecbolics.**
(2) **Asafetida.**
(3) **Myrrh.**
(4) **Guaiacum.**
(5) **Cantharides.**
(6) **Borax.**

Among the many indirect emmenagogues the commoner are purgatives, iron, manganese, cod-liver oil, and strychnine, which act by improving the general health. Hot foot or hip baths, especially if mustard be added, often aid the onset of menstruation.

E. Substances which depress Uterine Action.—These are employed to restrain the contractions of the gravid uterus. They are—

(1) **Bromides.**
(2) **Opium.**
(3) **Chloral.**
(4) **Cannabis indica.**
(5) **Chloroform.**
(6) **Tartarated antimony.**

F. Drugs acting on the Secretion of Milk.

Galactogogues, or drugs which increase the secretion of milk.

Jaborandi and **Alcohol.**—Of these jaborandi is the most powerful, but its effects soon pass off. Alcohol is very feeble. The secretion is so much under the control of the general health that the best way to ensure an abundant secretion is to keep the general health as good as possible.

Antigalactogogues, or drugs which decrease the secretion of milk.

Belladonna, either given internally or applied locally, is very efficient, probably acting locally on the mammary gland as on the sweat glands.

The following *drugs*, if given, are *excreted by the milk* and are therefore taken in by the child :—Oil of anise, oil of dill, garlic, oil of turpentine, oil of copaiba, and probably all volatile oils, sulphur, rhubarb, senna, jalap, scammony, castor oil, opium, iodine, indigo, antimony, arsenic, bismuth, iron, lead, mercury, zinc, potassium iodide. It is clear that these must be administered with care to the mother ; for example, copaiba or turpentine will make the milk so nasty that the child will not take it. The above purgatives given to the mother may cause diarrhœa in the child. Opium should not be given in large doses to the mother. On the other hand, mercury, arsenic, and potassium iodide may be administered to the child by being given to her.

Division XII.—Drugs acting on Metabolism.

Our knowledge of the normal metabolism of the body is very imperfect, consequently we know very little more than has been already stated under other divisions, about the action of drugs on metabolism.

Any further remarks which are necessary will be made when the individual drugs are considered. Two words in common use are alterative and tonic.

Alterative is a vague term of which no definition can be given. It is often used to cloak our ignorance, when we have no exact knowledge of the mode of action of a drug. Many drugs comprehended under this term have the property of profoundly altering the body, especially if it be diseased; for example, mercury will, if the patient be suffering from syphilis, generally cause the absorption of syphilitic exudations, but we do not know how this takes place. All that can be said about such drugs will be stated under each, for their mode of action is probably so different, that no useful purpose would be served by considering them together.

Tonic.—This is a term even more vague than alterative. So ill-defined is it, that it is advisable never to use it if it can be avoided. As commonly employed, it means a drug which makes the patient feel in more robust health than he did before he took it. Obviously this may happen in many ways, such as, for instance, by improving the digestion or the quality of the blood.

MATERIA MEDICA.

(All the substances about to be described are pharmacopœial unless the contrary is stated.)

PART I.—INORGANIC MATERIA MEDICA.

GROUP I.

WATER AND PEROXIDE OF HYDROGEN.

AQUA DESTILLATA.

Distilled water, H_2O.

SOURCE.—Prepared by distillation from good natura potable water.

TESTS.—Evaporated in a clean platinum capsule it leaves a scarcely visible residue. It is not affected by tests for metals, chlorides, nitrates, nitrites, or sulphates. Tested with sulphuric acid and potassium permanganate, it should only show faintest traces of organic matter, and tested with Nessler's test it should only show the faintest traces of ammonia. Aqua destillata is always to be used for making up prescriptions.

ACTION.*

External.—An indifferent bath (88°—98° F.), or one in which the bather feels neither hot nor cold, produces no particular effect.

Cold baths increase the production of heat, and abstract heat from the body if they are prolonged; therefore at first the bodily temperature may rise slightly, but when the loss exceeds the production it falls. The amount of carbonic acid expired is increased. The rate of the pulse and respiration at first rises, but they soon fall. The skin becomes pale, and the condition of goose-skin is seen. After the bath (the duration and temperature suitable for different persons varies widely) there is a feeling of warmth and exhilaration, and the cutaneous vessels dilate.

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* Unless otherwise stated, the word action will in this book always be taken to mean physiological action, or action in health.

A warm bath if sufficiently prolonged may cause a slight rise of the bodily temperature, the skin becomes red, the pulse and respirations are more frequent, the amount of urine secreted is diminished, and after the bath there is profuse perspiration.

Internal.—Warm water gives rise to nausea and vomiting. Water is quickly absorbed from the stomach, and very soon afterwards the amount of urine secreted is greatly increased, and to a less degree the amount of bile, pancreatic juice, and saliva. Large quantities of fluid should not be drunk during meal-times, as that impairs digestion. If a considerable amount of water is drunk daily the amount of urea excreted is increased, and that of uric acid is diminished. Water not only washes out the tissues, but apparently renders tissue metamorphosis more complete.

THERAPEUTICS.

External.—*Cold baths* are used for the subsequent exhilarating effects, which may be increased by quick rubbing with a rough towel. Persons in whom a feeling of warmth does not immediately follow a cold bath should not use them. The constant daily use of a cold bath probably diminishes the liability to catch cold. Cold baths are said to arrest attacks of laryngismus stridulus. They have been largely used to reduce the temperature in fever, especially **typhoid** fever. The first effect of putting the patient in the cold water is to cause, reflexly from the stimulation of the skin by the cold, an increased production of heat; for this reason and because of the cessation of radiation, the rectal temperature at first rises a little, but soon, owing to the direct abstraction of heat, and to the diminished production of heat which quickly sets in, it falls rapidly, and continues to do so after the patient is taken out. The temperature of a bath for a patient with typhoid fever should be between 68° and 58° F.; he should be lowered into it by a sheet, and remain in ten minutes, unless before that time he shows signs of collapse, he is then lifted back to bed, where a blanket is thrown loosely over him. If this treatment is adopted the bath ought to be given whenever the axillary temperature is 103° F. Sometimes the patient is placed in a bath at a temperature 10° F. below his own, and the water is cooled by putting in cold water or ice, till it has fallen to about 68° F., when he is taken out. Often instead of having a bath he is sponged with cold water as he lies in bed; this saves trouble, but both sponging and a cold pack (which consists of a sheet four folds thick wrung out in cold water and wrapped round the naked body for five or ten minutes) are inferior to a bath. **Pneumonia** is often treated by the application of cold, generally by means of ice poultices (pounded ice in a thin, flat, indiarubber bag), applied to the chest. The immediate application of very cold baths is by far the best treatment for any sudden **hyperpyrexia.**

Cold is applied **locally** either by cold water in Leiter's coils or ice bags, in a number of conditions, with the object of arresting inflammation. Thus ice bags are put on the head in meningitis, or concussion, and on the knee-joint for acute synovitis, &c. According to most authorities cold contracts not only the vessels of the skin to which it is applied, but by reflex action those of the organs see page 205

Internal.—Silver salts are not much used internally, and their continuous employment is objectionable on account of the discoloration of the skin produced. They were formerly often given in nervous diseases, but there is no evidence that they did any good. Although it is said that the compound of silver formed in the stomach is non-astringent, nitrate of silver will certainly check severe diarrhœa, especially that of children. Sixty grains of nitrate of silver dissolved in three pints of tepid water, and injected high up the rectum, have been used with great benefit in dysentery.

ZINCUM.

Zinc. Symbol, Zn. Atomic weight, 64·91. (Not official.)

1. Zinci Chloridum.—Zinc Chloride. $ZnCl_2$.

SOURCE.—Zinc chloride is prepared by the interaction of hydrochloric acid and zinc.

CHARACTERS.—Colourless opaque rods or tablets, very deliquescent and caustic. *Solubility.*—Freely soluble in alcohol, water, and ether.

IMPURITIES.—Iron, calcium, and sulphates.

Preparation.

Liquor Zinci Chloridi.—Treat zinc 1lb. with hydrochloric acid 44 fl. oz., and add water. Sp. Gr. 1·53.

ACTION OF ZINC CHLORIDE.

External.—It is very **caustic**, penetrating deeply, and limited in its effect to the seat of application. It is strongly **antiseptic**, and a solution of it of sp. gr. 2·0, known as Sir Wm. Burnett's fluid, is used as a domestic antiseptic.

Internal, *see* Toxicology.

THERAPEUTICS OF ZINC CHLORIDE.

External.—It is used as a powerful caustic, and is often made into sticks with plaster of Paris to destroy warts, nævi, condylomata, lupoid patches, &c. For the same purposes it may be made into a paste with equal parts of starch or flour. Either the liquor, or Burnett's fluid, may be employed to wash out bed-pans, closets, &c., but chloride of zinc is not so commonly used as other antiseptics. It is not given internally.

Toxicology.

Chloride of zinc is a corrosive irritant poison, causing a sensation of burning in the mouth and throat, abdominal pain, vomiting—the vomit containing blood, mucus, and shreds of mucous membrane—violent purging, and collapse. *Post mortem.*—The appearances are those produced by an acute irritant.

Treatment.—Wash out the stomach, or give emetics (*see* p. 129), and then demulcents (*see also* p. 129).

2. Zinci Sulphas.—Zinc Sulphate. $ZnSO_4,7H_2O$.

Source.—Made by the interaction of zinc and sulphuric acid.

Characters.—Minute colourless prisms, very like sulphate of magnesium, but having a metallic taste. *Solubility.*—10 in 7 of water.

Impurities.—Lead, iron, copper, arsenic.

Incompatibles.—Alkalies and their carbonates, lime water, lead acetate, silver nitrate, astringent vegetable infusions or decoctions, and milk.

Dose, 1 to 3 gr. (tonic); **10 to 30 gr.** (emetic).

Preparation.

Unguentum Zinci Oleatis.—Dissolve zinc sulphate, 2 oz., in distilled water; also dissolve 4 oz. of hard soap in shavings in distilled water. Mix the two solutions. Collect the zinc oleate; dry it and add an equal weight of white soft paraffin.

3. Zinci Carbonas.—Zinc Carbonate, Zinc Hydroxycarbonate. $ZnCO_3(Zn2HO)_2H_2O$.

Source.—Boil together solutions of zinc sulphate and sodium carbonate. $3ZnSO_4 + 2H_2O + 3Na_2CO_3 = ZnCO_3(Zn2HO)_2 + 2CO_2 + 3Na_2SO_4$. Dry the precipitated zinc salt.

Characters.—A white tasteless powder, insoluble in water. Similar in constitution to magnesium carbonate.

Impurities.—Sulphates, chlorides, copper.

Dose, 1 to 3 gr. (tonic); **10 to 30 gr.** (emetic).

Rarely used except to make the oxide and the acetate.

4. Zinci Oxidum.—Zinc Oxide. ZnO.

Source.—Prepared by heating the carbonate to redness in a crucible, or from metallic zinc by combustion.

Characters.—A soft, nearly white, tasteless powder, insoluble in water.

Impurities.—The carbonate and its impurities.

Dose, 3 to 10 gr.

Preparation.

Unguentum Zinci.—Zinc oxide, 3; benzoated lard, 17.

5. Zinci Acetas.—Zinc Acetate. $Zn(C_2H_3O_2)_2 3H_2O$.

Source.—Dissolve the zinc carbonate in acetic acid and water, and boil. $ZnCO_3(Zn2HO)_2,H_2O + 6C_2H_4O_2 = 3Zn(C_2H_3O_2) + 6H_2O + CO_2$. Zinc acetate crystallizes out.

Characters.—Thin, translucent, colourless, crystalline plates, with a pearly lustre and a sharp taste. *Solubility.*—10 in 25 of water.

Impurities.—Those of the carbonate.

Incompatibles.—The same as of the sulphate.

Dose, 1 to 2 gr.

6. Zinci Sulphocarbolas, *see* Acidum Carbolicum.

7. Zinci Valerianas, *see* Valerianæ Rhizoma.

ACTION OF ZINC SULPHATE, CARBONATE, OXIDE, OLEATE, AND ACETATE.

External.—These salts, when applied to the broken skin or an ulcerated surface, are all **astringents**, acting by precipitating the albumen in the discharge and also that in the tissues. Thus they resemble lead and silver salts, but as a whole they are less powerfully astringent. The most active of them are the sulphate and acetate, whilst the carbonate and oxide are very weak. All these zinc salts are mild hæmostatics.

Internal.—*Alimentary canal.*—They all have an astringent effect on the gastric and intestinal mucous membranes. The sulphate, and to a less degree the carbonate, in doses of about 20 grains are prompt emetics. They act directly on the stomach, and have the advantage of producing very little depression.

Remote effects.—Nothing is known about the remote action of zinc salts, nor do we know how they act on the blood. It has been stated that they are depressant to the nervous system as a whole, and that they act as remote astringents, and will therefore arrest hæmorrhage from the uterus, kidneys, &c., but this statement is probably incorrect.

THERAPEUTICS OF ZINC SULPHATE, CARBONATE, OXIDE, OLEATE, AND ACETATE.

External.—A solution of the sulphate, generally about 2 gr. to 1 fl. oz., usually coloured red with compound tincture of lavender, and then called Lotio Rubra, is very often applied for its astringent effect to all sorts of raw surfaces and ulcers, and as an injection in gonorrhœa, leucorrhœa, vulvitis, or otitis. Plain solutions of this strength may be applied to the eye for conjunctivitis. The oleate is an excellent application to sores and ulcers when a less astringent preparation is required; and the oxide and carbonate, either dusted on the parts or used as an ointment, are in constant use for cases in which only a mild astringent effect is desirable. An ointment, often known as Unguentum Metallorum, consists of equal parts of ointments of zinc oxide, lead acetate, and dilute mercuric nitrate. This is a very good application for many varieties of eczema, sores, and ulcers. Equal parts of zinc oleate, mercuric oleate, and diachylon ointment (p. 156) form an ointment which has the great advantage of being transparent, and therefore the progress of the disease can be observed without washing off the ointment.

Calamine (purified zinc carbonate) is an excellent slight astringent for skin diseases. An ointment (1 to 5 of benzoated lard) or a lotion (calamine, 15 gr.; zinc oxide, 15 gr.; lime water, 80 ♏; glycerin, 20 ♏; water, 1 fl. oz.) are good preparations.

Internal.—*Alimentary canal.*—On account of their disagreeable taste, solutions of zinc salts are not used as astringents to the mouth. Small doses of the oxide or sulphate may be given as astringents in diarrhœa. The sulphate is a very good emetic for cases of poisoning, for it acts promptly without causing much nausea and hardly any depression. It is occasionally given as an emetic to children suffering from laryngitis or bronchitis.

Remote effects.—Because it is believed to act as a depressant to the nervous system, zinc sulphate has been given in hysteria, epilepsy, whooping-cough, and chorea in doses of 1 to 3 grains thrice a day. Its use is now generally limited to chorea, but often its effect is so slow that it is difficult to prove that the patient would not have improved quite as rapidly without any drug. It is usually said to be a tonic, but there is no trustworthy evidence for this statement. The oxide given internally will occasionally check the night-sweats of phthisis.

CUPRUM.

Copper. Symbol, Cu. Atomic weight, 63·12. (Not official.)

Cupri Sulphas.—Copper Sulphate. $CuSO_4,5H_2O$
Synonyms.—Blue vitriol; Bluestone; Cupric sulphate.

SOURCE.—Obtained by the interaction of water, cupric oxide or copper and sulphuric acid.

CHARACTERS.—Deep blue crystals in triclinic prisms. Taste, styptic. *Solubility.*—1 in 3·5 of water. Solution strongly acid.

IMPURITY.—Iron.

INCOMPATIBLES.—Alkalies and their carbonates, lime water, mineral salts (except sulphates), iodides, and most vegetable astringents.

Dose, ¼ to 2 gr. (astringent); **5 to 10 gr.** (emetic).

ACTION OF COPPER SULPHATE.

External.—In the solid form this salt is, when applied to raw surfaces, a powerful **caustic**. In dilute solutions it is **astringent**, acting like zinc sulphate, but more powerfully.

Internal.—*Alimentary canal.*—Here also, if very concentrated or given in large doses, copper sulphate is an acute caustic irritant, but poisoning by it is very rare. In medicinal doses it is strongly **astringent**. Five to ten grains of the sulphate form a powerful **emetic**, acting directly on the stomach. As it is more irritating than zinc sulphate, it acts more readily, but it has the disadvantage that, if it fails to act, the stomach must be promptly emptied by some other means, for if not the copper sulphate will cause inflammation of it.

Remote effects.—Copper salts are slowly absorbed, and copper is chiefly re-excreted by the liver in the bile.

THERAPEUTICS OF COPPER SULPHATE.

External.—The sulphate is applied as a caustic to reduce exuberant granulations, and is used for tinea tarsi, being rubbed on the edges of the lids; as it is milder than nitrate of silver, it causes less pain. The "lapis divinus," which is often used for this last purpose, consists of copper sulphate 3 oz., potassium nitrate 3 oz., alum 3 oz., camphor 60 gr. The first three are fused together. The camphor is added, and the mass is cast into cylindrical moulds. Lotions of copper sulphate, usually about 2 gr. to 1 fl. oz., may be applied as astringents for just the same purposes as lotions of zinc sulphate; but it must be remembered that they are more powerful. This is the usual strength for solutions which are to be dropped into the eye. Rather stronger solutions are mild hæmostatics.

Copper oleate made, with lanolin, into an ointment of a strength of 10 to 20 per cent. is an excellent parasiticide for ringworm.

Internal.—In small doses copper sulphate is valuable for severe diarrhœa; usually it is given by the mouth in the form of a pill, but it may be given as a rectal injection. It is a rapid emetic, and may be employed in laryngitis and bronchitis in children, and in cases of narcotic poisoning, for which it is useful on account of its prompt action. It is particularly serviceable in phosphorus poisoning, for if it is used copper is deposited on the phosphorus, rendering it inert. It is usual to give three or four grains of the sulphate in water every few minutes till vomiting takes place. After emetic doses of copper sulphate there is generally only one act of vomiting, but by that the stomach is completely emptied. Very little is known about the remote action of salts of copper, but it is stated that the sulphate will cure chlorosis.

Toxicology.

Large doses act as gastro-intestinal irritants. Small doses taken for a long time produce pharyngeal and bronchial catarrh, colic, diarrhœa, salivation, anæmia, wasting, and jaundice. The liver becomes fatty. Occasionally nervous symptoms are seen.

BISMUTHUM.

Bismuth. Symbol, Bi. Atomic weight, 207·3. (Not official.

1. Bismuthi Carbonas.—Bismuth Oxycarbonate. $2(Bi_2O_2CO_3),H_2O$.

Source.—It may be prepared by the interaction of bismuth nitrate and ammonium carbonate.

Characters.—A heavy white powder, insoluble in water.

Impurities.—As of the subnitrate.

Dose, 5 to 20 gr.

Preparation.

Trochiscus Bismuthi Compositus.—Bismuth oxycarbonate, 2 gr.; heavy magnesium carbonate, 2 gr.; precipitated calcium carbonate, 4 gr.; and a rose basis.

2. Bismuthi Subnitras.—Bismuth Oxynitrate. $BiONO_3,H_2O$.

Source.—Prepared by the interaction of bismuth nitrate and water.

Characters.—A heavy white powder in minute crystalline scales. Insoluble in water, but soluble in dilute nitric acid.

Impurities.—Lead, arsenic, chlorides, nitrates.

Dose, 5 to 20 gr.

Preparation.

Liquor Bismuthi et Ammonii Citratis. *Synonym.*—Liquor Bismuthi. Dissolve 613 gr. of bismuth oxynitrate in 1 fl. oz. of nitric acid diluted with water. Add 613 gr. of potassium citrate and 175 gr. of potassium carbonate with a little water; heat to 212° F. Dissolve the precipitate in ammonia and add water to make a pint. Contains 3 gr. of bismuth oxide to 1 fl. dr.

Dose, $\frac{1}{2}$ to 1 fl. dr.

3. Bismuthi Oxidum.—Bismuth Oxide. Bi_2O_3.

Source.—Boil the oxynitrate in a solution of soda and dry the precipitate. $2BiONO_3 + 2NaHO = Bi_2O_3 + 2NaNO_3 + H_2O$.

Characters.—A dull heavy brownish-yellow powder, insoluble in water, soluble in nitric acid and water.

Dose, 5 to 20 gr.

4. Bismuthi Salicylas.—Bismuth Salicylate or Bismuth Oxysalicylate, $C_6H_4.OH.COO.BiO$, may be prepared by the interaction of bismuth nitrate and sodium salicylate.

Characters and Tests.—A white or nearly white heavy amorphous powder insoluble in water, alcohol, and glycerine. It gives the reactions for bismuth and a violet colour with ferric chloride.

Dose, 5 to 20 gr.

Action of Bismuth Salts.

External.—Salts of bismuth have no action on the unbroken skin. Dusted on a raw surface they form a protecting coat, are germicidal, and are very **mildly astringent.**

Internal.—It was formerly believed that the subnitrate and carbonate of bismuth were severe gastro-intestinal irritants, but this effect was due to the arsenic with which so many specimens of bismuth salts were contaminated. When pure, it is probable that these salts, like any bland heavy powder, act chiefly as protectives to the gastro-intestinal mucous membrane. They have a slightly **astringent** action, and are gastro-intestinal antiseptics. The subnitrate is believed to be the most powerful in this direction because in contact with water it tends to split up into bismuth oxide and nitric acid, and in the intestine bismuth sulphide is formed, and nitrous vapours, which are antiseptic, are liberated, but it may be that it acts as an oxygen carrier like arsenic. It is stated that bismuth is slowly absorbed and excreted chiefly in the urine, but the whole subject requires fresh investigation. Nothing is known of any remote effects. Bismuth leaves the rectum as the sulphide, and colours the fæces black. It may cause a purplish line on the gums.

THERAPEUTICS OF BISMUTH SALTS.

External.—Salts of bismuth may be dusted on sores as protectives and mild astringents. The following is a good bismuth ointment:—Bismuth oxide 1 part, and oleic acid 8 parts, stirred in with 3 parts of white wax liquefied by heat, with 9 parts of soft paraffin. The subnitrate is sometimes snuffed up the nose during a cold, and suspended in mucilage it may be used as an injection for gonorrhœa or leucorrhœa. Dermatol, which is bismuth subgallate, has been employed as an ointment and dusting powder.

Internal.—The subnitrate and the carbonate are chiefly employed, and they seem to be more efficient than the soluble preparations. They must be suspended in mucilage; given thus they are more efficacious than as a lozenge. It is not known how the effect is produced, but either of these salts is remarkably efficient in removing gastric pain, whether due to ulcer or to gastritis, or even when no cause can be detected. The usual dose is 10 or 20 gr. Both these drugs will often stop vomiting due to gastritis, gastric ulcer, chloroform, pregnancy, or indeed any other cause. For their astringent action they are given in diarrhœa, doses of 60 gr. being administered without any ill effect, and some believe that part of the benefit is due to the antiseptic action of bismuth salts. They appear sometimes to check the severe diarrhœa of tuberculous ulceration of the bowel. Their efficacy as gastric anodynes and as gastric astringents is much increased by combination with a little morphine, and if given as gastric sedatives the addition of sodium bicarbonate as well as the morphine is an advantage. In such a prescription the bismuth carbonate is preferable to the subnitrate, for the latter may act on the sodium carbonate and lead to the production of sufficient carbonic acid to drive the cork out of the bottle.

The salicylate has been largely used in various gastric affections. It is supposed to combine the virtues of bismuth salts with the antiseptic actions of salicylic acid.

GROUP V.

Iron and Manganese.

It is probable that these two drugs have a very simi physiological action.

IRON.

Ferrum. Symbol, Fe. Atomic weight, 55·6. (Official.

1. Ferrum.—Annealed iron wire, diameter 0·005 in or wrought-iron nails, free from oxide.

Metallic iron is pharmacopœial in two forms, viz. this and reduced iron.

Preparation.

Vinum Ferri. *Synonym.*—Steel wine. Iron wire, 1 oz.; sherry, 1 pint. Digest for thirty days. *Strength.*—1 in 20.

Dose, 1 to 4 fl. dr.

2. Ferrum Redactum.—Reduced Iron. A fine powder containing at least 75 per cent. of metallic iron with a variable amount of iron oxide.

Source.—Ferric hydroxide is precipitated with ammonia from a dilute solution of iron perchloride. It is heated in a gun-barrel, and reduced by having hydrogen passed over it.

Characters.—A greyish-black powder, strongly attracted by the magnet.

Impurity.—Sulphur.

Dose, 1 to 5 gr.

Preparation.

Trochiscus Ferri Redacti. *Strength.*—1 gr. of reduced iron in each with a simple basis.

The following (viz. the sulphate, the carbonate, the arsenate, the phosphate, and the iodide) *are ferrous salts* : that is to say, salts of the lower oxide of iron, FeO. The iodide is not itself official, but preparations containing it are.

3. Ferri Sulphas.—Ferrous Sulphate. $FeSO_4,7H_2O$.

Source.—Iron wire is dissolved by boiling in sulphuric acid and water. The sulphate is crystallized out.

Characters.—Pale green, oblique rhombic prisms, with a styptic taste. *Solubility.*—1 in 1½ of water.

Impurities.—Per-salts of iron, copper.

Dose, 1 to 5 gr.

Preparation.

Mistura Ferri Composita. *Synonym.* — "Griffith's mixture." Ferrous sulphate, 25 gr.; potassium carbonate, 30 gr.; myrrh, 60 gr.; sugar, 60 gr.; spirit of nutmeg, 50 ♏; rose water, 10 fl. oz. It is a dark green mixture containing the iron carbonate, for the iron sulphate and the potassium carbonate act on each other.

Dose, ½ to 1 fl. oz.

4. Ferri Sulphas Exsiccatus. — Exsiccated Ferrous Sulphate. $FeSO_4,H_2O$ (called Dried Sulphate of Iron B. P. 1885).

Source.—Heat the sulphate to 212° F. It loses six-sevenths of its water of crystallization.

Characters.—A dirty white powder which easily absorbs water, and therefore pills made of it may spoil. 2½ gr. = 4 gr. of the sulphate.

Dose, ½ to 3 gr.

Preparations.

1. Pilula Ferri. *Synonym.* — Blaud's pill. Exsiccated ferrous sulphate, 150; exsiccated sodium carbonate, 95; gum acacia, 50; tragacanth, 15; glycerin, 10; syrup, 150; water, a sufficiency. Divide into 5-gr. pills. Each contains 1 gr. ferrous carbonate, the same change taking place as in Mistura Ferri Composita.

Dose, 5 to 15 gr.

2. Pilula Aloës et Ferri, *see* Aloes.

5. Ferri Carbonas Saccharatus.—Ferrous oxycarbonate, $xFeCO_3\,yFe(OH)_2$, more or less oxidized and mixed with sugar. The carbonate, $FeCO_3$, forms about one-third of the mixture.

Source.—Precipitate a solution of ferrous sulphate with ammonium carbonate. The iron carbonate thus precipitated, by exposure takes up oxygen. It is rubbed up with sugar.

Characters.—Grey lumps of a sweetish taste. It is a very unstable compound, being easily oxidized. The sugar in both this preparation and in Blaud's pill forms a coating, and prevents further oxidization. The saccharated carbonate of iron should not be given in a mixture, for the sugar is dissolved out, and then the compound can decompose.

Impurities.—Ammonium sulphate, excess of iron oxide.

Dose, 10 to 30 gr.

6. Ferri Arsenas. — Iron Arsenate (called Arseniate of Iron in B. P. 1885). It consists of both ferrous, $Fe_3(AsO_4)_2 6H_2O$, and ferric arsenates, with some iron oxide.

Source. — Mix hot solutions of sodium arsenate and ferrous sulphate, add sodium bicarbonate to neutralize the free sulphuric acid that is formed. Arsenate of iron is precipitated.

CHARACTERS.—A greenish amorphous powder, insoluble in water.

IMPURITIES.—Sulphates.

Dose, $\frac{1}{16}$ to $\frac{1}{4}$ gr. as a pill.

7. Ferri Phosphas.—Iron Phosphate. It consists of both ferrous phosphate, $Fe_3(PO_4)_2 8H_2O$, and ferric phosphate, with some iron oxide.

SOURCE.—Made exactly as Ferri Arsenas by substituting sodium phosphate for sodium arsenate.

CHARACTERS.—A slate-blue amorphous powder, insoluble in water. It contains not less than 47 per cent. of the hydrous ferrous phosphite.

IMPURITY.—Arsenic.

Dose, 5 to 10 gr.

Preparation.

1. Syrupus Ferri Phosphatis.—Dissolve iron wire, 75 gr., in concentrated phosphoric acid, 6 fl. dr., and add syrup. *Strength.*—1 gr. of ferrous phosphate in each fluid drachm.

Dose, $\frac{1}{2}$ to 1 fl. dr.

2. Syrupus Ferri Phosphatis cum Quinina et Strychnina. *Synonyms.*—Easton's Syrup, Syrupus Trium Phosphatum. Iron wire, 75 gr.; concentrated phosphoric acid, 10 fl. dr.; powdered strychnine, 5 gr.; quinine sulphate, 130 gr.; syrup, 14 fl. oz.; water to make 20 fl. oz.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Each fl. dr. represents 1 gr. of ferrous phosphate, $\frac{4}{5}$ gr. of quinine sulphate, and $\frac{1}{32}$ gr. of strychnine.

8. Syrupus Ferri Iodidi.—Make a hot solution of iron wire and iodine in water and add it to syrup. It is colourless. *Strength.*—5·5 gr. of ferrous iodide in 1 fl. dr. It is very liable to change, forming the oxyiodide of iron and free iodine. This can be prevented by immersing in the syrup a coil of iron wire, or by adding a small quantity of hypophosphorous acid. It should be kept in the dark.

Dose, 30 to 60 m.

The following (viz. the perchloride, the oxychloride, the persulphate, the pernitrate, and the acetate) *are ferric salts*;

they are compounds of the higher oxide of iron, Fe_2O_3. Most are official in the form of liquors.

9. Liquor Ferri Perchloridi Fortis.—Strong Solution of Ferric Chloride.

Source.—Boil iron in hydrochloric acid and water. $Fe + 2HCl = FeCl_2 + H_2$. Nitric acid is then added, and thus the ferrous is converted into ferric chloride. $6FeCl_2 + 6HCl + 2HNO_3 = 3Fe_2Cl_6 + 4H_2O + 2NO$. *Strength.*—22·5 per cent. of iron.

Characters.—An orange-brown liquid, usually containing some free hydrochloric acid.

Impurities.—Ferrous salts.

Preparations.

1. Liquor Ferri Perchloridi.—The strong solution, 1; water, 3.

Dose, 5 to 15 m.

2. Tinctura Ferri Perchloridi.—The strong solution, 1; alcohol (90 per cent.), 1; water, 2. It will be noticed that the Liquor and the Tincture are the same strength.

Dose, 5 to 15 m.

10. Liquor Ferri Persulphatis.—Solution of Ferric Sulphate. $Fe_2,3SO_4$.

Source.—A hot solution of ferrous sulphate in sulphuric acid and water is boiled with nitric acid and water. $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3(Fe_2,3SO_4) + 4H_2O + 2NO$.

Characters.—A dark red very astringent solution, miscible with water.

11. Liquor Ferri Pernitratis.—Solution of Ferric Nitrate. $Fe_2,6(NO_3)$.

Source.—Dissolve iron wire in nitric acid and water. $Fe_2 + 8HNO_3 = Fe_2,6NO_3 + 4H_2O + 2NO$. *Strength.*—3·3 per cent. of iron.

Characters.—A clear reddish-brown liquid, astringent.

Impurities.—Ferrous salts.

Dose, 5 to 15 m.

12. Liquor Ferri Acetatis.—Solution of Ferric Acetate. $Fe_26(C_2H_3O_2)$.

Source.—Ferric sulphate is precipitated with a dilute solution of ammonia. $Fe_2,3SO_4 + 6NH_4,HO = Fe_2,6HO +$

$3(NH_4)_2SO_4$. The resulting hydrate is dissolved in glacial acetic acid. $Fe_2,6HO + 6HC_2H_3O_2 = Fe_2,6(C_2H_3O_2) + 6H_2O$.

CHARACTERS.—A deep red fluid, miscible with water or spirit.

Dose, 5 to 15 m.

The following are scale preparations of iron, so called because they are dried to form scales. They are not well-defined chemical compounds. The base of all is ferric hydrate. There are three—the tartarated iron, the ammonio-citrate, and the citrate of iron and quinine.

13. Ferrum Tartaratum.—Tartarated Iron.

SOURCE.—Dissolve freshly made ferric hydrate in a hot solution of acid potassium tartrate, evaporate to a syrup, and dry on sheets of glass.

CHARACTERS.—Garnet-coloured scales, slightly sweetish and astringent. *Solubility.*—1 in 4 of water; feebly in spirit.

IMPURITIES.—Ammonia and ferrous salts.

Dose, 5 to 10 gr.

14. Ferri et Ammonii Citras.—Iron and Ammonium Citrate.

SOURCE.—Dissolve ferric hydrate in a hot solution of citric acid, neutralize with ammonia, evaporate, and dry on sheets of glass.

CHARACTERS.—Red scales like the tartarated iron, but not so deep in colour. *Solubility.*—10 in 5 of water; almost insoluble in spirit.

IMPURITIES.—Tartrates and alkaline salts.

Dose, 5 to 10 gr.

Preparation.

Vinum Ferri Citratis.—Iron and ammonium citrate, 1 gr.; orange wine, 1 fl. dr.

Dose, 1 to 4 fl. dr.

15. Ferri et Quininæ Citras.—Iron and Quinine Citrate.

SOURCE.—Made like Ferri et Ammonii Citras, quinine being also dissolved in the citric acid solution.

CHARACTERS.—Greenish-yellow scales of a bitter taste. *Solubility.*—2 in 1 of water.

IMPURITIES.—Alkaline salts and other alkaloids instead of quinine.

Dose, 5 to 10 gr.

INCOMPATIBLES OF IRON SALTS IN GENERAL.—All substances containing tannic or gallic acid form an intense black with per-salts of iron. Preparations of iron are therefore incompatible with all vegetable astringent solutions, and the only infusions with which they can be prescribed are infusion of quassia and infusion of calumba. It is a common mistake to forget that because of its tannin, the tincture as well as the infusion of digitalis makes an inky mixture with iron preparations. Such a mixture may be clarified with a little dilute phosphoric acid, but after a few days a slight precipitate of phosphate of iron falls. Per-salts of iron render mucilage of acacia gelatinous.

Alkalies and their carbonates, lime water, carbonate of calcium, magnesia and its carbonate give green precipitates with ferrous, and brown with ferric salts.

ACTION OF IRON AND ITS SALTS.

External.—They have no action on the unbroken skin, but when applied locally to the abraded skin, sores, ulcers, and mucous membranes, many of the salts of iron, especially the **per-salts**, are powerful **astringents**, because they **coagulate albuminous fluids**, both those discharged from the surface and also those in the tissue itself. There is no direct effect on the walls of the vessels, but the contraction of the coagulated albumen compresses them and diminishes their calibre. Partly for this reason, but still more because these salts of iron quickly cause the coagulation of blood, and the clot thus formed plugs the bleeding vessels, they are the most perfect **local hæmostatics** we possess, and will often arrest very severe hæmorrhage. The perchloride, the sulphate, and the pernitrate of iron are all very strongly astringent; but the scale preparations, steel wine, reduced iron, the carbonate, the iodide, the arsenate, the phosphate, and the acetate of iron are so very feebly astringent that they are never used as local applications; in fact, to most persons they are non-astringent. Oxides of iron have the property of converting oxygen into ozone, and are therefore disinfectant.

Internal.—*Mouth.*—Preparations of iron have a styptic taste, the **teeth** and **tongue** may be **blackened** when they are taken owing to the formation of the sulphide of iron, the sulphur being derived from the food and the tartar on the teeth; hence it is advisable to take iron preparations through a glass tube or a quill. The astringent preparations have, when locally applied, the same action on the mucous membrane of the mouth as on the raw skin.

Stomach.—Whatever form of iron is given by the mouth, it is converted in the stomach into **ferric chloride,** with probably a little ferrous chloride. Long experience has shown that ferric chloride is to the physician a most valuable preparation of iron; probably this is because it will not abstract hydrochloric acid from the gastric juice as is the case with all other preparations of iron. It is often stated that an albuminate of iron is formed in the stomach; this is incorrect, and when the albuminate of iron is given by the mouth it will be converted into a chloride in the stomach. Although whatever form of iron is administered ferric chloride is formed in the stomach, the choice of the preparation is a matter of great importance; for if strongly acid salts are given, the acid set free after the formation of the chloride will act as an irritant, and damage the mucous membrane; even the preparations of the perchloride may do this, for they often contain a considerable amount of free acid. These facts explain why iron preparations, especially the acid ones, so often cause headache, nausea, loss of appetite, and other symptoms of severe indigestion. We also learn why experience has taught that the sulphate, which is so often used, should be given in the form of a pill, for this, especially if coated, is not dissolved till the intestine is reached, and the acid is harmless in the alkaline solutions of that part of the alimentary canal. Further, we see why the preparations which are either not acid at all or only very slightly acid, such as the reduced iron, dialysed iron (B. P. 1885), the carbonate, and the scale preparations, do not as a rule cause indigestion. The perchloride of iron is very astringent, hence the astringent effect on the stomach of iron salts. The non-astringent preparations can only be astringent in proportion to the amount of ferric chloride formed from them by the gastric juice; but if large quantities of astringent preparations are given, the excess which is not decomposed by the gastric juice will add its astringency to that of the perchloride formed in the stomach.

Intestines.—On passing into the intestine, the contents of which are alkaline from carbonate of sodium, the ferric chloride becomes an oxide of iron, which remains in solution owing to the presence of organic substances; the subchloride is converted into ferrous carbonate, which is also soluble. Lower down in the intestine, by the action of the sulphur compounds, the nascent hydrogen, and other readily oxidized products of decomposition there present, these compounds of iron are converted into the sulphide and tannate (the tannic acid being derived from the vegetables in the food), and as such are eliminated with the fæces, which are turned black. Large amounts of the astringent preparations have a **constipating effect**; this may be owing to there being an excess of them, for the oxides and carbonates are non-astringent preparations.

Absorption.—It was for a long time believed that iron, given as a drug, was absorbed as an alkaline albuminate and as a chloride, but this is almost certainly erroneous. Some authorities doubt, however, whether iron, when administered as any of the iron preparations used in medicine, is absorbed at all.

Thus a dog was fed on a meat diet; the amount of iron excreted in the urine was on the average 3·6 milligrammes a day. Then for nine days 49 mgrms. of iron as sulphate were given daily; for the first five subsequent days the excretion of iron in the urine did not increase, for the next six it increased by only two mgrms. a day, afterwards it returned to the normal amount; so that with an increase of 441 mgrms. of iron ingested only 12 mgrms. more than usual appeared in the urine. It is very likely that this slight excess in excretion may have been due to the fact that the large amount of iron taken corroded the intestinal epithelium, which therefore allowed a little iron to be absorbed. This experiment favours the view that no appreciable amount of iron given as a drug is absorbed, but it does not prove it, for it is possible that the iron may have been locked up in the body, or eliminated by some other channel than the urine; and of these suppositions the most likely is that it was excreted from the blood into the intestine. It is often stated that excretion of iron into the intestine takes place by the bile, but the most recent observations of Bunge and Hamburger show that the bile contains the merest traces of iron. In favour of iron being excreted into the intestines by the intestinal and gastric juices is the fact that the fæces of a fasting dog contain iron, but it is very little, and it must be remembered that the epithelium of the intestine, which is constantly being shed, normally contains iron. There is little doubt but that iron salts injected into the blood are excreted into the intestine, but this injection causes symptoms of poisoning, such as reduced blood-pressure, gastro-intestinal irritation, and paralysis of the muscles due to depression of the central nervous system. But as these symptoms never follow the administration of large amounts of iron salts by the mouth, it would appear that they are not absorbed, and this confirms the experiment already described. On the whole, therefore, although the question is not definitely settled, from these facts the balance of evidence is that iron salts given to animals as drugs are not absorbed from the intestine; but when discussing the cure of chlorosis by iron, we shall see reasons for thinking that in that disease iron is absorbed.

Blood.—It is often stated that the administration of iron causes, in healthy subjects, an increase in the number of red blood-corpuscles, but this is very doubtful. Probably in health it has little or no effect on the blood.

In certain forms of anæmia (a condition in which the amount of hæmoglobin and the number of corpuscles are diminished), especially chlorosis, the administration of iron rapidly improves the blood in both respects. It is therefore said to be **hæmatinic**; and as an improvement in the quality of the blood leads to an improvement in the functions of all the organs of the body, iron is also called a tonic. Tonics are drugs which indirectly improve the action of the several organs of the body; usually they act by improving the quality of the blood or by aiding digestion, and thus rendering the digestion and absorption of food more easy (*see* p. 109). We have seen that some believe that iron is not absorbed, and if this be so, it is at first sight difficult to understand how it can benefit anæmia. But the proposition that iron salts cannot be absorbed only refers to inorganic salts. It is obvious that iron in some form must be absorbed, if not the chicken could not get it from the yolk, and the growing child could not increase the quantity of its blood proportionately to its growth. It is noticeable that our food, like yolk of egg, only contains complex organic compounds of iron. As these must be absorbed we must conclude that they are in some way or other protected from decomposition in the alimentary canal, if we believe that the inorganic compounds which would result if they were decomposed are incapable of absorption. Bunge's hypothesis is that in some forms of anæmia, especially chlorosis, organic salts of iron taken in the food are in some way split up in the intestine so as to be incapable of absorption. In those anæmic conditions which can be benefited by iron the administration of the inorganic salts prevents the decomposition of the organic salts in the food by fixing the decomposing agents, which according to Bunge are chiefly alkaline sulphides, and forming sulphide of iron. This is supported by the fact that to cure chlorosis rapidly enormous doses of iron are often found necessary; for example, a patient will take 6 grains of reduced iron three times a day, or 18 grains a day. Now, the whole amount of iron in the blood of an ordinary healthy woman is not much more than 35 grains, for there is only one atom of iron in a molecule of hæmoglobin, which contains considerably over 2000 atoms. Supposing she had lost half her hæmoglobin, if the iron given were simply absorbed, one day's treatment would speedily restore her to health, but it is well known that weeks are often required. But if this view were correct we should expect that bismuth, manganese, or arsenic, by fixing the decomposing agents, would cure chlorosis as efficiently as iron. It has been stated that they will, but Stockman has published results which point in a contrary direction, and he has shown that sulphide of iron will cure chlorosis although on Bunge's hypothesis it should not, for it will not fix the decomposing agents if they are alkaline sulphides. Iron injected subcutaneously cures chlorosis, but this does not tell in one direction more than another, for it may be excreted into the intestine. But although there are many facts against Bunge's view, still it is by no means proved that iron given as a drug to chlorotic patients is absorbed.

Remote effects.—As iron in anæmic subjects increases the amount of hæmoglobin, more oxygen is carried to the tissues, and thus the whole body shares in the benefit of a course of iron, which has also been thought to have a direct effect on the kidneys as a mild diuretic, and a direct effect in promoting the menstrual flow. These actions are, however, slight, and may be due to the general improvement in health. Iron salts have been given to produce abortion, but without any result. Remote astringent effects have been attributed to them, but there is no satisfactory proof that they have any; and indeed, when we remember that very little if any iron is absorbed in an astringent form, and it cannot exist in the blood in such a form, we should hardly expect that salts of iron could be remotely hæmostatic or astringent. Iron is chiefly stored in the spleen, lymphatic glands, liver, and marrow; possibly it is by stimulating the activity of this that iron cures chlorosis.

Excretion.—Only traces of iron are eliminated in the urine.

Therapeutics of Iron and its Salts.

External.—Solutions of the sulphate, the perchloride, the pernitrate, and the Liquor Ferri Subsulphatis, $Fe_4O(SO_4)_5$, strength 43 p.c., official in the United States (Monsel's solution), are the most valuable local astringents we have. It matters very little which of these is used. In England one of the solutions of the perchloride is perhaps oftenest employed. Either is of service in many cases—for example, to stop hæmorrhage from leech-bites, from the nose, from piles, or from the uterus, as in the hæmorrhage of malignant disease. A convenient way to apply them is on lint or cotton wool soaked in the solution, and a cavity such as the nose or uterus may be plugged with the lint. The aqueous solution of the perchloride has been used as a spray for hæmoptysis, but as it may excite coughing it is not to be recommended. It is very useful as an astringent for painting on the fauces, pharynx, or tonsils in inflammation of these parts. It may for this purpose be diluted with an equal quantity of water, or a solution of 1 part of perchloride of iron in 4 of glycerin may be used. It has been advised to paint erysipelatous skin with the tincture of perchloride of iron. A solution of the sulphate (1 gr. to 1 fl. oz.) has been used in gleet.

Internal.—*Gastro-intestinal tract.*—The astringent preparations may be swallowed in cases of severe bleeding from the stomach, such as that of malignant disease, ulcer, or cirrhosis. If the bleeding is profuse, a drachm of the Liquor Ferri Perchloridi with a drachm of glycerine to facilitate swallowing may be given every hour or oftener, and this will sometimes apparently save a patient's life. For less serious hæmorrhage smaller quantities will suffice. Intestinal hæmorrhage may also be treated in the same way.

The tendency of the per-salts of iron to constipate is usually overcome by the addition of some purgative ; thus magnesium sulphate is commonly given with the perchloride, and aloes is often prescribed with iron sulphate in a pill. The per-salts have been given for diarrhœa, but there are many drugs more suitable for this symptom. Chronic constipation is often very effectually treated by a pill of iron sulphate and extract of nux vomica, but probably the efficient purgative in it is the nux vomica, although some claim that large doses of iron sulphate will overcome chronic constipation. Anyhow the constipating effect of the ferric salts is often much exaggerated.

A rectal injection of a fluid drachm of the tincture of the perchloride of iron to half a pint of water kills threadworms.

Arsenical poisoning is best treated by the humid peroxide of iron, which should be freshly prepared by mixing together 3 fl. oz. of Liquor Ferri Perchloridi with 1 oz. of sodium carbonate diluted with water. Half an ounce should be given every five or ten minutes. An insoluble arsenite is formed, and may be got rid of by a thoroughly purgative dose of magnesium sulphate or some other simple purge. A dose of common salt or sodium bicarbonate, followed by 1 fl. oz. of the Liquor Ferri Dialysatus of B. P. 1885 diluted with water, is also efficient in poisoning by arsenic.

Blood.—The great use of iron salts is to restore the amount of hæmoglobin and the number of red corpuscles in anæmia, especially chlorosis. They are useless in pernicious anæmia and generally of little value, if any, in the anæmia of leucocythæmia, exophthalmic goitre, or Hodgkin's disease. All other common forms of anæmia are secondary to some definite cause, such as hæmorrhage, lead poisoning, scurvy, &c., and are treated by the removal, if possible, of the cause of the anæmia, but recovery may be aided by the administration of iron. The perchloride and the sulphate of iron are two of the most efficacious preparations, and pills containing a grain of the dried sulphate, with aloes or nux vomica if constipation is present, or the Pilula Ferri, are very valuable. It is usual to begin with one pill containing one grain of the dried sulphate of iron thrice a day, but gradually the number of pills may be increased till three or four are taken at a dose. This method of large doses of the sulphate often appears to cure more rapidly than smaller doses. If these astringent preparations cause indigestion, any of the milder preparations may be substituted. The carbonate may be given in pills in rapidly increasing doses, or the dose of reduced iron, conveniently given on bread and butter, may be pushed. Mistura Ferri Composita is a disagreeable preparation to take and to look at. The styptic taste of some of the preparations, especially the astringent ones, may be concealed by giving them with a drachm of glycerin, which acts by its viscosity and by reducing some of the ferric to a ferrous salt. It is often added to the tincture of the perchloride. The scale preparations hardly ever disagree, they are therefore used for patients with a delicate digestion, and for such it is much better to make no attempt to rapidly increase the dose, but to depend on small doses spread over a long period. Mineral waters containing iron (such as those of La Bourboule and Levico) may be given in such cases, but they are not often advisable, as they contain so little iron. Flitwick water, however, contains a good deal. Treatment of anæmia by iron leads, of course, to the improvement of the numerous symptoms, such as amenorrhœa, constipation, dyspepsia, &c., which are dependent upon the anæmia. That form of neuralgia which is associated with anæmia usually yields to iron.

Syrupus Ferri Phosphatis cum Quinina et Strychnina (see p. 173) or Easton's syrup is a very popular preparation; it is used for anæmia, and to promote the health and appetite during convalescence after long illnesses. A pill very similar to the syrup, and containing iron phosphate, 1 gr.; quinine, 1 gr.; strychnine, $\frac{1}{32}$ gr.; concentrated phosphoric acid, 1½ ♏; liquorice powder to 5 gr., is prepared. It is called Easton's pill, or Pilula Trium Phosphatum. A similar tabloid is in the market.

The iodide of iron has been given, sometimes apparently with success, in cases of rheumatoid arthritis.

Large doses of iron (10 or even 20 minims of the tincture of the perchloride every hour or two) have been given in diphtheria and other forms of bad sore-throat, such as hospital sore-throat, apparently with considerable benefit. Erysipelas has been treated in the same way. Fever due to other causes is said to contra-indicate the use of iron.

Kidneys.—Iron salts are reported to have a feeble diuretic action, but this is doubtful. The perchloride is often given empirically for all forms of Bright's disease. Whether it does good is at present undecided.

As iron is liable to cause indigestion, it should not be given near a meal. Occasionally a patient is found who cannot take iron in any form, because of the headache and indigestion caused by it.

The different preparations of iron.—These have already been classified into astringent and non-astringent. There are some, viz. the arsenate, the iodide, the phosphate, and the citrate of iron and quinine, the value of which depends in part at least upon their other ingredient. The arsenate must be given in such small doses to avoid arsenical poisoning that it is probable that the iron in it has no effect. Hence arsenious acid may just as well be given, and this is commonly done. The iron phosphate, which always contains some free phosphoric acid, is an excellent hæmatinic. It is used largely for children, because the syrup of it is very pleasant in taste, and also because it was formerly believed that the phosphoric acid would aid the growth of bones, especially in cases of rickets. The iron iodide has been introduced for cases in which we wish to gain the benefit of both elements, but the proportion of iron to iodine is small (1 to 4½). It is especially liable to damage the teeth. The citrate of iron and quinine combines the virtues of both iron and quinine. It is a favourite mild preparation for slight cases of anæmia, but must not be prescribed with alkalies, as they precipitate the quinine.

Parrish's Food.—(Not official.)

A complicated preparation. The Syrupus Ferri Phosphatis Compositus of the British Pharmaceutical Conference corresponds to it. The ingredients of this are iron wire, concentrated phosphoric acid, precipitated calcium carbonate, potassium bicarbonate, sodium phosphate, cochineal, sugar, and distilled water.

Dose, ½ to 2 fl. dr.

Dusart's Syrup.—(Not official.)
The chief ingredient of this is iron phosphate.
Dose, ½ to 2 fl. dr.

ACTION AND THERAPEUTICS.

These are pleasant preparations, given for the sake of the phosphates and iron in them. Children take them easily.

MANGANESIUM.

Manganese. Symbol, Mn. Atomic weight, 54·52. (Not official.)

Potassii Permanganas.—Potassium Permanganate. $K_2Mn_2O_8$.

SOURCE.—It may be obtained by the interaction of potassium chlorate, potassium hydroxide, and manganese dioxide.

CHARACTERS. — Dark purple, delicate, slender prisms. *Solubility.*—1 in 20 of water; a grain gives a fine purple colour to a gallon of water.

INCOMPATIBLES.—It is very readily deoxidized in the presence of organic matter. It is usually given as a pill or a tabella, and should be made up with kaolin, or an explosion will very likely take place.

IMPURITIES.—Potassium carbonate, black manganese oxide.

Dose, 1 to 3 gr. as a pill.

Preparation.

Liquor Potassii Permanganatis. *Strength.*—1 per cent. solution in distilled water. It has a very nasty taste, and is easily deoxidized in the presence of organic matters to a brown colour.
Dose, 2 to 4 fl. dr.

ACTION OF POTASSIUM PERMANGANATE.

External.—In the solid form it is a mild caustic and is, when kept dry, a permanent salt. Its most important action is that when moist it readily gives up its oxygen in the presence of organic bodies, and its solutions therefore quickly turn dark brown, manganese dioxide being formed. The power possessed by its solution of giving up oxygen makes it a **disinfectant, deodorant,** and **antiseptic,** especially as much of the oxygen is in the form of ozone. But its action as a germicide is very limited, for it so readily gives up its oxygen to the organic substances in which the micro-organisms flourish that it very soon becomes inert.

Internal.—Potassium permanganate when taken internally must be quickly decomposed. Manganese salts cannot be absorbed by the intestine unless its epithelium is damaged. When they are injected into the blood they are excreted in the urine and into the intestine. Probably their action much resembles that of iron salts, but very little is known on this point.

THERAPEUTICS OF POTASSIUM PERMANGANATE.

External.—Although potassium permanganate is not of much practical use as a germicide, it is commonly employed as a deodorant for drains, bed-pans, to wash utensils, and to wash the hands; for the last purpose it is suitable as being non-irritant. It has one advantage: namely, that it is easy by its change in colour to see when it has lost its efficacy. 1 in 150 is a serviceable strength. Condy's red fluid consists of 8 grains of potassium permanganate to the fluid ounce of distilled water. It is expensive for purposes requiring a large quantity. It stains fabrics. The stain may be got out by applying sulphurous acid, but the fabric must be immediately rinsed in water, for sulphuric acid is formed.

Internal.—The official liquor of potassium permanganate considerably diluted can be used as a mouth wash or gargle in foul conditions of the mouth, or as an injection in cases of foul discharges, such as may occur with gonorrhœa, vaginitis, uterine disease, or ozæna. Some have considered that potassium permanganate is beneficial for the same cases of anæmia as iron, but probably it has no effect. Others praise its power in amenorrhœa. It should always be given as a pill or tabella, for the taste of solutions of it is very nasty. It oxidizes morphine and is therefore an antidote to opium poisoning.

GROUP VI.

Containing **Mercury** only.

1. HYDRARGYRUM.

Mercury. Quicksilver. Symbol, Hg. Atomic weight, 198·8.

SOURCE.—Cinnabar, the native sulphide, is roasted or distilled with lime.

CHARACTERS.—A brilliantly lustrous fluid metal, easily divisible into small globules. Boils at 662° F. Solidifies at −40° F.

IMPURITIES.—Lead, tin, and other metals.

Preparations containing free mercury.

1. **Hydrargyrum cum Cretâ.** *Synonym.*—Grey powder. *Strength.*—1 of mercury with 2 of prepared chalk. By keeping, the mercury is liable to become mercuric oxide, which makes the powder more active.

Dose, 1 to 5 gr.

2. **Emplastrum Hydrargyri.**—Mercury, 164; olive oil, 7; sublimed sulphur, 1; lead plaster, 328. *Strength.*—1 in 3 of mercury.

3. **Emplastrum Ammoniaci cum Hydrargyro.**—Mercury, 164; olive oil, 7; sublimed sulphur, 1; ammoniacum, 656. *Strength.*—1 in 5 of mercury.

4. **Linimentum Hydrargyri.**—Mercurial ointment, 1; strong solution of ammonia, $\frac{1}{3}$; camphor liniment, $1\frac{1}{2}$. *Strength.*—1 in 6 of mercury, nearly.

5. Pilula Hydrargyri. *Synonym.*—Blue pill. Mercury, 1; confection of roses, 1½; liquorice, ½. *Strength.*—1 in 3 of mercury.

Dose, 4 to 8 gr.

6. Unguentum Hydrargyri. *Synonym.*—Blue ointment. Mercury, 16; lard, 16; suet, 1. *Strength.*—1 in 2 of mercury. After this ointment has been kept some time it contains metallic mercury, mercuric oleate, and mercurous and mercuric oxides.

7. Unguentum Hydrargyri Compositum. *Synonym.*—Scott's ointment. Mercurial ointment, 10; yellow wax, 6; olive oil, 6; camphor, in flowers, 3. *Strength.*—1 in 5 of mercury.

2. Hydrargyri Oxidum Rubrum.—Red Mercuric Oxide. HgO. *Synonym.*—Red precipitate.

Source.—Obtained by heating mercurous nitrate until acid vapours cease to be evolved.

Characters.—An orange-red powder or crystalline scales, almost insoluble in water.

Impurities.—Red lead, brickdust, nitrate of mercury.

Dose, ¼ to 1 gr.

Preparation.

Unguentum Hydrargyri Oxidi Rubri. *Synonym.*—Red precipitate ointment. Red Mercuric oxide, 1; yellow paraffin ointment, 9.

3. Hydrargyri Oxidum Flavum.—Yellow Mercuric Oxide. HgO.

Source.—Precipitate a solution of mercuric chloride with caustic soda.

Characters.—A yellow powder, insoluble in water. Not given internally. It is contained in Lotio Hydrargyri Flava. It has the same composition as the red oxide, but is more crystalline.

Preparation.

Unguentum Hydrargyri Oxidi Flavi.—Yellow mercuric oxide, 1; yellow soft paraffin, 49.

4. Hydrargyri Perchloridum.—Perchloride of Mercury, Mercuric Chloride. *Synonym.*—Corrosive sublimate. $HgCl_2$.

SOURCE.—Heat a mixture of mercuric sulphate, sodium chloride, and manganese dioxide. $HgSO_4 + 2NaCl + MnO_2 = HgCl_2 + Na_2SO_4 + MnO_2$. The perchloride sublimes and is condensed.

CHARACTERS.—Heavy, colourless masses of prismatic crystals. *Solubility.*—1 in 16 of water; 1 in 3 of alcohol (90 per cent.). It must be dissolved in distilled water, for ordinary water decomposes it.

INCOMPATIBLES.—Alkalies and their carbonates, potassium iodide, lime water, tartar emetic, silver nitrate, lead acetate, albumen, soaps, vegetable preparations containing tannic acid, and in fact most substances.

Dose, $\frac{1}{32}$ to $\frac{1}{16}$ gr.

Preparations.

1. Liquor Hydrargyri Perchloridi.—Mercuric chloride, 10 gr.; distilled water, 1 pint. *Strength.*—$\frac{1}{2}$ gr. to 1 fl. oz., or $\frac{1}{16}$ gr. to 1 fl. dr.

Dose, 30 to 60 m.

2. Lotio Hydrargyri Flava. *Synonym.*—Yellow wash. Mercuric chloride, 40 gr.; lime water, 1 pint. The insoluble yellow oxide is formed thus: $HgCl_2 + Ca(OH)_2 = HgO + CaCl_2 + H_2O$. *Strength.*—2 gr. in 1 fl. oz.

5. Hydrargyri Subchloridum.—Subchloride of Mercury, Mercurous Chloride. *Synonym.*—Calomel. Hg_2Cl_2.

SOURCE.—Rub mercury with mercuric sulphate to form the mercurous sulphate, Hg_2SO_4. Add sodium chloride, and then heat. Calomel sublimes. $Hg_2SO_4 + 2NaCl = Hg_2Cl_2 + Na_2SO_4$.

CHARACTERS.—A dull white, heavy, insoluble, nearly tasteless powder.

IMPURITY.—Mercuric chloride.

Dose, $\frac{1}{2}$ to 5 gr.

Preparations.

1. Lotio Hydrargyri Nigra. *Synonym.*—Black wash. Calomel, 30 gr.; glycerin, $\frac{1}{2}$ fl. oz.; mucilage of tragacanth, $1\frac{1}{4}$ fl. oz.; lime water, to make 10 fl. oz. The insoluble black or mercurous oxide is formed. It is suspended in the mucilage of tragacanth. $Hg_2Cl_2 + Ca(OH)_2 = Hg_2O + CaCl_2 + H_2O$. *Strength.*—60 gr. to the pint, or 3 gr. to 1 fl. oz.

2. **Pilula Hydrargyri Subchloridi Composita.** *Synonym.*—Plummer's pill. Calomel, 1; sulphuretted antimony, 1; guaiacum resin, 2; castor oil, $\frac{3}{8}$; alcohol (90 per cent.), $\frac{1}{8}$. *Strength.*—Calomel, 1 in $4\frac{1}{2}$.

Dose, 4 to 8 gr.

3. **Unguentum Hydrargyri Subchloridi.**—Calomel, 1; benzoated lard, 9.

6. Hydrargyri Oleas.—Mercuric Oleate.

SOURCE.—Mix oleic acid, 1 fl. dr., with hard soap, 2 oz. Dissolve in water and boil with 1 oz. of mercuric chloride dissolved in water.

CHARACTERS.—A light greyish yellow, oleaginous, semi-solid substance.

Preparation.

Unguentum Hydrargyri Oleatis.—Mercuric Oleate, 1; benzoated lard, 3.

7. Hydrargyri Iodidum Rubrum.—Red Iodide of Mercury, Mercuric Iodide, Biniodide of Mercury. HgI_2.

SOURCE.—Mix hot solutions of mercuric chloride and potassium iodide. Filter and dry the precipitated red iodide.

CHARACTERS.—A vermilion crystalline powder, feebly soluble in water, but easily in a solution of potassium iodide.

IMPURITIES.—The same as of the perchloride.

Dose, $\frac{1}{32}$ to $\frac{1}{16}$ gr.

Preparations.

1. **Liquor Arsenii et Hydrargyri Iodidi.** *Synonym.*—Donovan's solution. Dissolve equal parts of arsenious iodide and mercuric iodide in water. A clear pale yellow liquid. *Strength.*—1 per cent. of each iodide.

Dose, 5 to 20 m.

2. **Unguentum Hydrargyri Iodidi Rubri.**—Mercuric iodide, 1; benzoated lard, 24.

8. Hydrargyri Iodidum Viride.—Hg_2I_2. (Not official.) Green Iodide of Mercury. *Synonym.*—Subiodide of mercury.

SOURCE.—Rub together mercury and iodine with a few drops of spirit.

CHARACTERS.—A dull green powder insoluble in water. Must be kept in the dark, for it very soon becomes the red iodide. Keeps better if a slight excess of mercury is present.

Dose, $\frac{1}{6}$ to 2 gr. in a pill.

9. Liquor Hydrargyri Nitratis Acidus.—Mercuric Nitrate, or Pernitrate of Mercury. $Hg(NO_3)_2$ in solution in nitric acid.

SOURCE.—Dissolve 4 oz. of mercury in 5 fl. oz. of nitric acid with $1\frac{1}{2}$ fl. oz. of water, and heat.

CHARACTERS.—A colourless, strongly acid liquid containing much free nitric acid. Sp. gr. 2·0.

IMPURITY.—Mercurous nitrate.

10. Unguentum Hydrargyri Nitratis. *Synonym.*—Citrine ointment.

SOURCE.—Mix a solution of 1 of mercury in 3 of nitric acid, with 4 of lard and 7 of olive oil.

CHARACTERS.—A lemon-yellow ointment.

Preparation.

Unguentum Hydrargyri Nitratis Dilutum. Mercuric nitrate ointment, 1; soft yellow paraffin, 4.

11. Hydrargyrum Ammoniatum.—Ammoniated Mercury. NH_2HgCl. *Synonyms.*—White precipitate, ammonio-chloride of mercury.

SOURCE.—Mix solutions of ammonia and perchloride of mercury. $HgCl_2 + 2NH_4OH = NH_2HgCl + NH_4Cl + 2H_2O$. Filter and wash the precipitated ammoniated mercury.

CHARACTERS.—An opaque white powder, very insoluble.

IMPURITIES.—The same as of the perchloride.

Preparation.

Unguentum Hydrargyri Ammoniati. *Synonym.*—White precipitate ointment. Ammoniated mercury, 1; white paraffin ointment, 9.

ACTION OF MERCURY AND ITS SALTS.

External.—The **perchloride of mercury** is one of the **most powerful** and important **antiseptics** with which we are acquainted. In 1870 it was discovered that 1 part in 6000 would kill infusoria and spermatozoa. Now it is known to be a universal germicide. The published results of experiments with it vary very much, because the duration of the action, the solvent, and the micro-organism experimented upon are not always the same. Evans (‘Guy's Hosp. Rep.,’ vol. xlvii.) found that anthrax spores were destroyed by corrosive sublimate solutions of 1 in 1000 acting for a quarter of an hour, and 1 in 3000 acting for one hour. The bacilli themselves were destroyed by solutions of 1 in 15,000 acting for one minute, and 1 in 25,000 acting for half an hour. A solution of 1 in 70,000 prevented the growth of the spores, and one of 1 in 500,000 prevented the growth of the bacilli. A reference to carbolic acid will show how much more powerful corrosive sublimate is. A solution of 1 in 1000 is very commonly employed for many disinfecting purposes. If albumen be present in the fluid to be disinfected an albuminate of mercury is formed, and the antiseptic value of the fluid is destroyed. This change may be prevented by the addition of 5 parts of either hydrochloric or tartaric acid to 1 of corrosive sublimate. The biniodide is also a powerful antiseptic. Metallic instruments cannot be disinfected with the perchloride, for mercury is deposited on them.

Most mercurials, especially the oleate, oxide, ammoniate, nitrate, and perchloride, will destroy the animal and vegetable parasites that infest the skin; they are therefore **antiparasitic.** Also most of them will occasionally relieve itching, even when no cause is to be found.

The mercuric preparations, especially the red iodide and the acid solution of the nitrate, are powerful irritants. The latter is strongly caustic. Mercurous salts are slightly irritant and stimulating;

calomel is sometimes applied to sores for this property.

Metallic mercury and its salts are **absorbed by the skin**, especially when rubbed in either as an oleate or an ointment. These preparations are also taken up, although to a less degree, if simply applied to the skin, for minute particles of mercury or its salts pass into the hair follicles and sebaceous follicles, from which they are absorbed as an oxide or a chloride. All the symptoms of mercurial poisoning can be produced if the drug is absorbed through the skin. The **vapour** can be **absorbed** through the mucous membrane of the **lungs**, and mercury compounds are so volatile that when they are applied to the skin some usually enters the blood by the lungs.

Internal.—Although the different salts of mercury have different external actions, after absorption their actions are, in most respects, similar. The long-continued use of excessive doses of mercurials produces well-marked and important symptoms (*see* Toxicology). The actions for which mercurials are used in medicine are the following.

Stomach and Intestines.—The **metal** mercury itself and **mercurous** compounds, being **mildly irritant** in their action, are often used as **purgatives**; but the mercuric compounds given in the same doses produce severe gastro-intestinal irritation. The action is chiefly on the duodenum and upper part of the jejunum; the precise mode of irritation is unknown, but it is certain that, in consequence of the administration of the mercurial, the contents of the duodenum are hurried along before there is time for the bile to be reabsorbed, and hence the motions are very dark-coloured. There is probably some, but not an excessive increased secretion from the intestinal walls, for the motions, although large and loose, are not watery. As the action of the mercurial is chiefly on the upper part of the intestine it is greatly assisted by giving a saline purge a few hours after it, for this will act more on the lower part of the bowel. The contents are passed along so quickly, that it is doubtful whether there is time for much mercury to be absorbed if a purgative dose of it has been given. Calomel and the metallic preparations are the two forms most used as purgatives. The former is the more powerful.

Whatever compound of mercury is taken by the mouth, it, in the stomach, becomes a complex albuminate containing mercury, sodium, chlorine, and albumen. This compound, in the presence of the sodium chloride in the stomach, can exist in solution there. This same compound is formed when perchloride of mercury is injected subcutaneously, and therefore the solution for injection should contain a little sodium chloride. Precisely what happens to it in the duodenum is doubtful, but it is quite certain that if the dose is insufficient to cause purgation some mercury is absorbed, the rest passing out of the bowel as a sulphide.

Liver.—It was formerly taught that calomel increased the amount of bile formed by the liver. This is now known to be an error, but perchloride of mercury increases it, and possibly, occasionally when calomel is administered, some of it is converted into the perchloride. Large doses of calomel are said to slightly diminish the secretion of bile. Calomel and, to a less extent, preparations of metallic mercury are, however, called **indirect cholagogues**, because they, in the manner already explained, aid the excretion of bile. The stools are dark green and contain calomel, mercuric sulphide, and unaltered bile.

Blood.—After absorption the mercurial compound formed in the stomach and intestines probably becomes oxidized, and circulates as an oxyalbuminate. Minute long-continued doses of mercury slightly increase the richness of the blood in red corpuscles, and may add a little to the weight of the body. **Large doses** produce **anæmia.** Mercury checks the emigration of white corpuscles, and this perhaps explains its antiphlogistic action.

Remote effects.—Mercury is excreted by the saliva, bile, urine, sweat, bowels, and milk. In small doses no effects can be attributed to this, but in large doses mercury irritates the salivary glands and is a powerful **sialogogue.** By itself it is a feeble diuretic, but it sometimes powerfully aids other diuretics. It is eliminated very slowly, and hence accumulates in the body.

THERAPEUTICS OF MERCURY AND ITS SALTS.

External.—*Antiseptic action.*—Solutions of the perchloride are very largely employed. A strength of 1 in 1000 is used for washing the hands, for washing the parts to be operated upon, for soaking towels, lint, sponges, &c., used in operations, for washing infected articles, infected rooms, furniture, linen, &c. For wounds and cavities (as the uterus), the strength for a single washing should not exceed 1 in 2000, for continual irrigation 1 in 10,000.

Antiparasitic action.—White precipitate ointment, dilute nitrate of mercury ointment, and a wash of the perchloride are very useful for destroying lice on the head; and these three, especially the last, are excellent for destroying the fungus in ringworm and favus. The mercuric oleate is useful for destroying that in pityriasis versicolor; if the skin is easily irritated the ointment of it should be used. Mercurials should not be applied over so large an area that there is a risk of poisoning from absorption.

Irritant action.—The acid solution of the nitrate is used to destroy warts, condylomata, &c.; no doubt much of its caustic action is due to the free nitric acid it contains. Milder preparations, such as the dilute ointment of the nitrate, or the red oxide ointment if diluted, may be used for tinea tarsi; and the same ointments are very beneficial to any ulcer or sore that requires a stimulant, whether or not it be syphilitic. When a milder preparation is required calomel is often dusted on the part; and black wash is very commonly used, especially for syphilitic sores and condylomata.

Itching.—Black wash, yellow wash, or Unguentum Hydrargyri may be employed to relieve the itching of skin diseases, such as prurigo senilis and urticaria, if they are not too extensive. A very favourite ointment for many skin diseases is composed of equal parts of the dilute mercuric nitrate, zinc oxide, and lead acetate ointments (*see* p. 164).

Absorbent action.—All mercurial ointments and the oleate, when applied to or gently rubbed into any part which is chronically inflamed, often aid the absorption of the products of inflammation, if they are not too deep-seated. For this purpose blue ointment and Scott's ointment, or the oleate ointment, are very commonly used for chronic inflammation of joints, chronically enlarged glands, and chronic peritonitis, which certainly sometimes appears to be cured by the application of a binder spread with one of these preparations or the Linimentum Hydrargyri, even when the disease is tuberculous. The ointment of the red iodide is in India applied to the thyroid gland in goitre.

Internal.—*Alimentary canal.*—Very dilute solutions of the perchloride (4 gr. to 10 fl. oz. water with 8 ♏ of dilute hydrochloric acid) may be used as a mouth wash for syphilitic ulceration. Ringer advises grey powder in minute doses for the sudden vomiting immediately after food sometimes met with in children. By far the most important intestinal action of mercury is its purgative effect. Calomel and blue pill are preeminently the purgatives to employ when there is, from the headache, constipation, furred tongue, feeling of weight over the liver, and general lassitude, reason to suspect that the dyspepsia is hepatic. Either of these drugs at night, followed by a watery purge, as Mistura Sennæ Composita, in the morning, will often completely relieve the symptoms. The blue pill at night and black draught (Mistura Sennæ Composita) in the morning have long been a favourite combination. Mercury or calomel is also one of the best purgatives for cases of cirrhosis, and for cardiac cases in which there is considerable hepatic congestion. Grey powder mixed with a little sugar is an excellent purgative for children, or even for adults, when a very mild purge is required —as, for example, after severe enteritis or peritonitis, or if it is desirable to open the bowels during typhoid fever. Children take mercury very well. Infants can easily bear grain doses of the grey powder. As diarrhœa, especially in children, is so often due to the presence of some irritant, a simple purgative, as grey powder, will, by removing it, often cure the diarrhœa. This preparation hardly ever causes griping, but calomel is liable to do so. Mercury compounds are, on account of their intestinal antiseptic action, much given in Germany for typhoid fever (see pp. 75 and 88).

Remote uses.—In cases of heart disease mercury is often combined with digitalis and squill as a diuretic (as in the well-known Guy's diuretic pill: blue pill 12 gr., powdered squill root 12 gr., powdered digitalis leaves 12 gr., extract of hyoscyamus 20 gr.; make 12 pills), and in some cases this combination does great good.

Syphilis.—Mercury in any form is powerfully antisyphilitic. This action is so important that it makes mercury one of the most valuable drugs we have. It has already been mentioned that it may be applied locally to syphilitic ulcerations, but to be of any use it is essential that it should also be administered so as to reach the blood. It is a direct antidote to the syphilitic virus, it can completely cure the patient, its use must be continued over a long time, but it should never be pushed to salivation. Treatment should be begun at as early a stage as possible. It is especially valuable in the primary and secondary stages; authorities differ as to its value in tertiary syphilis. It is as efficacious for the congenital as for the acquired disease. It is also administered for many non-syphilitic varieties of chronic inflammation, but not so often as formerly. Patients with disease of the kidneys do not bear it well.

The green iodide is commonly prescribed for syphilis, and often succeeds when other preparations have failed. Its great disadvantage is its instability.

Sal Alembroth.—(Not official.)

Ammonio-mercuric Chloride, a double chloride of mercury and ammonium.

SOURCE.—Mix 271 parts of corrosive sublimate with 107 of ammonium chloride, both in solution, and evaporate.

CHARACTERS.—Flattened rhombic prisms, freely soluble in water or glycerin. It contains one molecule of corrosive sublimate combined with two of ammonium chloride. Three grains of sal alembroth contain two grains of corrosive sublimate. It is a very powerful antiseptic, but does not combine with albumen so readily as perchloride of mercury, and it is therefore less irritating.

ACTION AND THERAPEUTICS.

Sal alembroth gauze (containing 1 per cent.) and sal alembroth wool (2 per cent.), both tinted with aniline blue, which is bleached by the discharge, so that it is easy to see if it has soaked through, are much used to dress wounds antiseptically. Mercurozinc cyanide gauze (containing 3 per cent.) being unirritating is also used. It is tinted pink.

Sal alembroth injections ($\frac{1}{3}$ gr. in 10 ♏ of water) are a convenient non-irritating form in which to inject mercury subcutaneously in syphilis.

Modes of administration of mercurials.—(1) **By the mouth.**—The Liquor Hydrargyri Perchloridi is often given to adults, usually in doses of 1 to 2 fl. dr. For the later symptoms of syphilis, potassium iodide is often combined with it. Periodide of mercury is formed and is kept in solution by the excess of potassium iodide. Mercurous iodide, or the green iodide of mercury (p. 193), is much used by some. It is insoluble in water and is incompatible with potassium iodide, the red iodide and metallic mercury being formed. The best preparation for children is ½ to 1 gr. of grey powder, given just often enough to avoid purgation.

(2) **By the rectum.**—Occasionally mercury is given as a suppository.

(3) **Endermically.**—Mercurials, especially calomel, are often dusted on sores and ulcers, and lotions are also locally applied. Mercury can be absorbed in this way.

(4) **By inunction.**—Blue ointment may be rubbed into the skin. The best position is the inner side of the thigh. Usually a piece the size of the top of the thumb rubbed in once a day is enough. It has been put inside the sock, for then it is rubbed into the foot during walking. A very efficient way of applying the ointment in children is to smear it on a flannel binder which is worn round the abdomen. The oleate may be employed for inunction. Mercury is rapidly absorbed by these means.

(5) **Hypodermically.**—One-eighth of a grain or less of the perchloride dissolved in about 5 to 8 ♏ of distilled water with a trace of sodium chloride is used for a dose. The needle of a hypodermic syringe is plunged deeply into some muscles, preferably those of the gluteal region, and to the outer side of it, so that the patient does not sit or lie on the spot. One-sixth of a grain of morphine in solution may be injected. The needle is left *in situ*, the syringe is taken off and filled to the required dose with the perchloride solution, which is injected through the needle. If much pain is caused, a piece of ice may be held over the part before the injection and after the needle is withdrawn. The injection should be repeated daily. Before going to bed is a good time. With proper care no abscesses result, and after a few injections the morphine is usually unnecessary. This is a very rapid and thorough way of bringing the patient under the influence of mercury. Mercuric cyanide (dose, $\frac{1}{20}$ to $\frac{1}{10}$ gr.) is also a good salt for subcutaneous injection.

(6) **Fumigation.**—Calomel is used. The patient, who is naked, sits on a cane-bottom chair; a blanket, which reaches to the floor, is fastened lightly round his neck. Twenty grains of calomel are placed in a porcelain dish over a spirit lamp under the chair. The calomel volatilizes, and is absorbed by the skin. A bath should last twenty minutes; with obvious modifications this method may be applied to patients in bed.

(7) **Inhalation.**—This is rarely or never used.

(8) **Baths** of three drachms of the perchloride to thirty gallons of water, with one fluid drachm of hydrochloric acid added, have been used, but they are very rarely employed.

TOXICOLOGY.

Acute poisoning is rare. Salts of mercury, especially the per-salts, produce severe gastro-intestinal irritation, causing great pain, vomiting, and diarrhœa. Corrosive sublimate and white precipitate are the preparations usually taken.

Chronic poisoning by mercury or its salts produces a train of remarkable symptoms. They were very common when it was the practice to give larger doses of mercurials than are now employed, and they are occasionally seen in those who work in mercury. In the present day, when the patient shows any sign of mercurialism, the dose is reduced. These symptoms (which constitute hydrargyrism or mercurialism) may be brought about however the mercury is taken. The first indications noticed are slight fœtor of the breath and soreness of the gums when the teeth are knocked. Then follows a disagreeable metallic taste in the mouth, the gums become swollen and soft, and they bleed readily. Next there is a considerable increase in the amount of saliva secreted. All these symptoms gradually become more marked, and the tongue swells. The teeth are now loose, the saliva, which is thick and viscid, pours over the mouth, the parotid and salivary glands are enlarged and tender, and there is a slight rise of temperature. In olden days these symptoms occasionally ended in the falling out of the teeth, extensive ulceration of the mouth and tongue, necrosis of the jaw, great weakness, emaciation, anæmia, a watery state of the blood, a liability to hæmorrhages, exhaustion, and death.

More rarely the symptoms are, for the most part, nervous. These occur chiefly, if not entirely, among those who work in the metal and inhale the vapour. The first to be observed is tremor, beginning in the face, then invading the arms, and afterwards the legs. Early in the case the trembling is seen only on movement; soon it is permanent. It resembles paralysis agitans. Usually there is considerable weakness of the affected muscles ("mercurial palsy"). There may be pains, and a weak mental condition is common. Nothing has been found, post mortem, to account for these symptoms.

GROUP VII.

Arsenic, Antimony, Chromium.

The compounds of these metals have several physiological and some chemical points in common. The oxide of each is externally a powerful caustic. Internally, arsenic, antimony, and (as far as we know) chromium compounds are severe gastro-intestinal irritants. Arsenic and antimony in large doses both cause general fatty degeneration.

ARSENIUM.

Metallic Arsenic. Symbol, As. Atomic weight, 74·5.
(Not official.)

1. Acidum Arseniosum.—Arsenious Anhydride. *Synonyms.*—Arsenic; Arsenious Acid; White arsenic. As_4O_6.

Source.—Arsenical ores are roasted and purified by sublimation.

Characters.—A heavy white powder, or stratified opaque white masses. The strata are caused by the presence, in separate layers, of the crystalline and opaque, and of the amorphous and vitreous allotropic modifications of arsenious anhydride. *Solubility.*—1 in 100 of cold, 1 in 10 of boiling water. When volatilized and sublimed, it forms minute, transparent, brilliant octahedral crystals. When heated it gives off a garlic-like odour.

Incompatibles.—Lime water, salts of iron, magnesia.

Impurities.—Lime salts.

Dose, $\frac{1}{60}$ to $\frac{1}{15}$ gr.

Preparations.

1. Liquor Arsenicalis. *Synonym.*—Fowler's solution. Arsenious acid, 87½ gr.; potassium carbonate, 87½ gr.; boil in 10 fl. oz. of water, and add compound tincture of lavender, 5 fl. dr.; water, 10 fl. oz. Probably no decomposition occurs, but an alkaline solution of arsenious acid is formed. *Strength.*—1 gr. of arsenious acid in 110♏, or 1 per cent.

Dose, 2 to 8 m.

2. Liquor Arsenici Hydrochloricus.—Arsenious acid is boiled with hydrochloric acid and water. No decomposition occurs, but an acid solution of arsenious acid is formed. *Strength.*—1 gr. of arsenious acid in 110♏, or 1 per cent.

Dose, 2 to 8 m.

2. Sodii Arsenas.—Sodium Arsenate, Disodium Hydrogen Arsenate. Na_2HAsO_4 (Arseniate of Sodium, B. P. 1885).

Source.—Expose to a temperature of 300° F. crystallized sodium arsenate, which may be prepared by treating with water the product of the fusion of arsenious anhydride with sodium nitrate and sodium carbonate.

Characters.—A white powder. The hydrous form, which contains seven molecules of water of crystallization, is often seen, and was official in B. P. 1885.

Solubility.—1 in 6 of water. The solution is alkaline.

Dose, $\frac{1}{40}$ to $\frac{1}{10}$ gr.

Preparation.

Liquor Sodii Arsenatis. *Strength.*—1 per cent. of anhydrous sodium arsenate in distilled water. It contains about half as much metallic arsenic as Liquor Arsenicalis.

Dose, 2 to 8 m.

3. Arsenii Iodidum.—Arsenious Iodide. AsI_3.

Source.—Made by the direct union of iodine and metallic arsenic.

Characters.—Small orange-coloured crystals or crystalline masses. Soluble in water and in alcohol. Solution neutral.

Dose, $\frac{1}{20}$ to $\frac{1}{5}$ gr.

Preparation.

Liquor Arsenii et Hydrargyri Iodidi. *Synonym.*—Donovan's solution. *See* Mercury, p. 192.

4. Ferri Arsenas, *see* Iron, p. 172.

Action of Arsenical Compounds.

External.—Arsenious acid has no action on the skin, but applied to raw surfaces it is a powerful caustic.

Internal.—*Alimentary canal.*—Unless the dose be very small, all preparations containing arsenic are very severe **gastro-intestinal irritants** (*see* Toxicology). Part at least of this effect is due to excretion of the arsenic into the stomach after absorption, for if given subcutaneously there may be no local effect, although there is intense gastritis soon after injection. In minute doses they are gastric stimulants, causing dilatation of the gastric vessels and an increased flow of gastric juice. Small doses also stimulate the duodenum.

Blood.—Arsenic is absorbed into the blood. Nothing is known of its physiological action there, but it can in some forms of anæmia increase the hæmoglobin and the number of red corpuscles.

Circulation.—In the frog the rapidity and force of the heart are lessened till it finally stops. This is a local action, for it takes place when applied to the excised heart. Large doses destroy the capillaries and lead to hæmorrhage.

Remote effects.—In many diseases arsenic evidently profoundly affects metabolism, for the patient recovers under treatment by this drug. It is doubtful whether if given in small doses to healthy persons it usually does more than sharpen the appetite. It has been stated by Dogiel to unite with albumen; another view, that of Binz and Schulz, is that arsenious acid becomes arsenic acid by taking oxygen from the protoplasm, but that the arsenic acid subsequently yields up the oxygen again and that the activity of arsenic is due to its being a carrier of oxygen. Some of the people in Styria eat white arsenic in small quantities, and it is said to increase their strength and clear their complexion. Wood concludes that small doses of arsenic check tissue change and decrease nitrogenous elimination, whilst toxic doses have the opposite effect. But there is no proof of any of these statements, and we have no certain knowledge of the influence of arsenic on nutrition, nor do we know of any action to which its beneficial effects in many diseases can be referred, but as the drug certainly in some way alters the condition of the sufferer it is vaguely called an alterative. It is said to act on bones like phosphorus. It is eliminated by the urine, by the alimentary canal, the skin, the saliva, the milk, and even the tears, but it is also stored in the body, chiefly in the liver and kidneys. It may be found many years after death in the bodies of those who have taken it during life.

Therapeutics of Arsenical Compounds.

External.—Formerly arsenious acid was used as a caustic to destroy growths, lupus, warts, &c., either pure or as a paste. Arsenious acid, 1 part; charcoal, 1 part; red sulphide of mercury, 4 parts; and water, q. s., is the formula of a paste once very popular. It must be used strong enough to make the mass of dead tissue slough out quickly, or else the patient becomes poisoned, for the arsenic is rapidly absorbed. Arsenious acid $\frac{1}{8}$ grain with a grain of calomel, vermilion, or black antimony make a caustic powder. Liquor Arsenicalis has been recommended by Ringer as an application for corns.

Internal.—*Alimentary canal.*—Arsenious acid is useful to destroy the tooth pulps before stopping teeth.

In some forms of dyspepsia small doses of the Liquor Arsenicalis are occasionally given to stimulate the appetite. Arsenic is so liable to cause sickness, diarrhœa, and other symptoms of poisoning, that it is a rule always to begin a course of it with small doses, say 3 or 4 ♏ of the Liquor Arsenicalis, or $\frac{1}{60}$ to $\frac{1}{40}$ gr. of arsenious acid as a pill, and to gradually increase the quantity. Arsenic in any form should always be taken immediately after meals, so as to dilute it by the contents of a full stomach. Children bear it well, old people do not. Very small doses sometimes check vomiting, especially that form in which the food simply regurgitates, and in exceptional cases it may succeed in checking diarrhœa when other drugs have failed.

Remote effects.—Arsenic is of great value in chronic superficial skin diseases not owing their cause to an irritant. It is therefore largely used for psoriasis, pemphigus, and sometimes for chronic eczema. It is of no use in the acute stages of these maladies, nor if cutaneous inflammation is deep-seated.

Cases of anæmia which cannot be cured by iron, and which fall under the heading of primary anæmia, may be occasionally much improved by arsenic. Such are pernicious anæmia, splenic leucocythæmia, and Hodgkin's disease; but often no drug is of any avail. In other forms of anæmia, such as chlorosis, arsenic may be tried, but not often with benefit, when iron compounds disagree. Arsenic is, next to quinine, the best antiperiodic we have, but it is not nearly so efficacious. It may, however, in the absence of quinine, be used for ague, and is especially valuable for the anæmia which follows ague, and for neuralgia due to the same cause. It often does distinct good in rheumatoid arthritis if given for a long while. It is frequently prescribed for chorea, but it is difficult to prove that the cases get well more quickly than they would without any drug. Arsenic has been strongly recommended in asthma and in hay fever. For asthma it may be given by the mouth, or smoked as cigarettes, made by saturating bibulous paper in a solution of fifteen grains of potassium arsenite to an ounce of water. It has been given in phthisis, but without benefit.

TOXICOLOGY.

Acute Poisoning.—White arsenic is frequently used as a poison. Soon after taking it the sufferer experiences faintness, nausea, sickness, epigastric pain and tenderness. These symptoms quickly increase. The vomit is brown, and often see [illegible]

streaked with blood; the pain is very severe; there is profuse diarrhœa, with much tenesmus; and there are cramps in the calves of the legs. The vomiting becomes violent and incessant; there is a burning sensation in the throat, with intense thirst. Soon severe collapse sets in; the skin is cold, the pulse small and feeble, and the patient dies collapsed. The symptoms frequently bear a close resemblance to those of cholera. *Post mortem.*—The stomach is intensely inflamed, even if the arsenic has not been taken by the mouth, but has been applied in large quantities to cancerous growths. This shows that arsenic is excreted from the blood into the stomach. The small intestines are also acutely inflamed.

Treatment.—Wash out the stomach. Give emetics (p. 129), choosing the least irritating and least depressing. The stomach must be completely emptied. Give unlimited quantities of freshly prepared humid peroxide of iron (p. 184) or dialysed iron (p. 184). If neither of these is handy, give magnesia in large amounts, or large doses of castor oil and water. Give brandy or ether subcutaneously; apply hot blankets and bottles to the feet and the abdomen.

Chronic Poisoning.—Often, when arsenic is taken as a medicine, slight symptoms of poisoning are seen. They are loss of appetite, nausea, perhaps vomiting, slight abdominal pain, and mild diarrhœa. The eyelids become a little puffy, the conjunctivæ injected, the eyes and nose water, and there is slight headache. These symptoms, of course, show that the dose given is too large, and that it must be decreased.

Arsenic is so often used in the manufacture of all sorts of articles, especially wall papers and fabrics, that chronic poisoning by it is frequently seen. It is also met with in workers in arsenic, and in persons to whom it has been given with intent to murder. The symptoms produced are those already mentioned as present when large doses of arsenic are taken medicinally.

Long-continued use of arsenic may induce peripheral neuritis; the chief symptoms of arsenical neuritis are herpes zoster, paralysis of the muscles of the limbs, especially the extensors of the hands and feet, ataxic gait, severe darting pains in the limbs, and rapid muscular atrophy. Several cases are recorded in which arsenic has caused general brown pigmentation of the skin. It may also give rise to brown pigmentation of patches of psoriasis, and in quite exceptional cases cause eczema or urticaria. After death from chronic poisoning, in addition to the gastro-intestinal and nervous lesions, there is widespread fatty degeneration of most of the underneath it. This explains the application of an ice bag to the chest to arrest pulmonary hæmorrhage. Cold locally applied is therefore **hæmostatic.**

Warm baths, as they liquefy the fatty secretions, are more cleansing than cold. Hot baths like any other application of heat, **soothe pain**, hence they are useful for rheumatoid arthritis and colic, whether renal, biliary, or intestinal. By bringing blood to the skin, and lessening the amount in the internal organs, they **relieve muscular spasm**, such as we find in stricture of the urethra, colic, laryngismus stridulus, other forms of laryngeal spasm, and infantile convulsions. In the same way they are of service in weariness from muscular or cerebral activity, and are useful in many inflammatory affections, as, for example, a cold in the head. A warm bath immediately before going to bed may sometimes cure insomnia. The subsequent **increased perspiration** makes hot baths and hot packs of great value in the various forms of nephritis and in uræmia. Great care must be taken after a hot bath which has been given to induce sweating to see that the patient is kept warm by being wrapped quickly in a hot blanket and put into a warm bed; if not, the cutaneous vessels soon contract, and there is no diaphoresis. A local hot bath has the same effects, but to a less degree. A hot foot bath is often used for a cold in the head, or for amenorrhœa. Sponging with hot water will, by the vascular dilatation and sweating it causes, reduce the temperature slightly in fever.

A cold bath is one the temperature of which is below 70° F., one between 88° and 98° F. is properly speaking indifferent, but it is often called a warm bath. A tepid bath is intermediate between warm and cold. Anything above 98° F. is a hot bath. Few people can bear a temperature much over 102° F.

Internal.—The chief therapeutic use of water is to wash out the tissues, especially the kidneys, and to keep the urine dilute. Some persons who are liable to the formation of **gravel** or urinary calculi can by drinking plenty of pure water prevent their formation, for the minute collections of crystals which are the beginning of all calculi, are washed out of the urinary system before they have time to grow to any size, and if they are composed of uric acid the copious drinking of water diminishes the liability of their formation, for it decreases the amount of uric acid excreted. It is stated that the liability to the formation of gall-stones may also be kept in check by the drinking of plenty of water, as then the bile becomes less concentrated and flows more quickly. When large quantities of water are drunk it should be pure distilled water, and should be taken between meals. A glass of cold water taken on rising in the morning will with some persons cause the bowels to be opened. Warm water is an emetic.*

LIQUOR HYDROGENII PEROXIDI.

An aqueous solution of Peroxide of Hydrogen, H_2O_2.

SOURCE.—Prepared by the interaction of water, barium peroxide, and a dilute mineral acid at a temperature below 50° F.

TESTS.—When tested it should yield between nine and eleven times its volume of oxygen.

CHARACTERS.—Colourless, odourless liquid; slightly acid taste. Renders the saliva frothy.

Dose, $\frac{1}{2}$ to 2 fl. dr.

USES.

It is a powerful disinfectant (it is the active ingredient of Sanitas), and may be applied to ulcers and used as a mouth wash. It bleaches and is used as a hair dye. Internally it has been recommended for many diseases, especially diabetes, epilepsy, and uræmia, but the proof of its efficacy is slight.

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* It is impossible in this book to give more than a brief sketch of baths and the drinking of water and mineral waters. Further information will be found in works on 'General Therapeutics.'

GROUP II.

THE ALKALINE METALS.

Potassium, Sodium, Ammonium, Lithium.

POTASSIUM.

Symbol, K. Atomic weight 38·83. (Not official.)

1. Liquor Potassæ.—Solution of Potash. KHO.

SOURCE.—An aqueous solution of potassium carbonate is boiled with slaked lime. The supernatant liquid is syphoned off. $K_2CO_3 + Ca(OH)_2 = CaCO_3 + 2KHO$.

CHARACTERS.—A colourless alkaline fluid with a soapy feel and taste. Sp. gr. 1·058, *Strength* 5·85 per cent., or 25·5 gr. to 1 fl. oz. of potassium hydroxide in water. To be kept in green glass bottles with air-tight stoppers.

IMPURITIES.—Carbonic acid, lime, sulphates, chlorides and alumina.

INCOMPATIBLES.—Acids, acid salts, metallic salts and preparations of ammonia, belladonna, hyoscyamus and stramonium, the alkaloids of these three being decomposed by Caustic Potash. All alkaloids are precipitated by alkalies.

Dose, 10 to 30 m., freely diluted.

2. Potassa Caustica.—Caustic Potash. Potassium Hydroxide. KHO. *Synonym.*—Potassæ hydras.

SOURCE.—Evaporate liquor potassæ and cast the residue in moulds.

CHARACTERS.—Hard, deliquescent, corrosive white pencils.

IMPURITIES.—The same as of liquor potassæ. Should contain not more than 10 per cent. of combined water and impurities.

ACTION OF POTASH.

External.—It is, if concentrated, a powerful irritant and caustic, acting by abstracting water from the part to which it is applied. It dissolves fatty matters that may be present on the surface. It is **antacid**, and, if freely diluted, **sedative**.

Internal.—*Mouth.*—As alkalies check alkaline secretions, potash momentarily checks the secretion of saliva.

Stomach.—Because alkalies stimulate acid secretions the flow of gastric juice is **excited** if alkalies are given before a meal, and it is important to remember that this increased secretion of acid continues even after it has neutralized the alkali. If they are given after a meal the gastric juice already secreted is **neutralized.** Being readily diffusible alkalies are quickly absorbed.

Blood.—This is rendered more alkaline. Probably all alkalies circulate in the blood as carbonates, but their action as alkalizers of the blood is very transitory, for they are quickly excreted. The amount of hæmoglobin, if it is deficient, is said to be increased. The continual use of alkalies diminishes the quantity of fat.

Heart.—Large amounts of salts of potassium are **depressant** to all muscular tissues, and therefore decrease the force of the heart, ultimately causing diastolic arrest by direct action on the cardiac muscle.

Kidneys.—Potassium salts are **diuretic,** acting directly on the renal epithelium. They are quickly excreted in the **urine,** rendering it **alkaline,** and thus increasing its power of holding uric acid in solution.

Respiratory passages.—The bronchial secretion is generally **increased** in quantity, and it is rendered less viscid, but with some cases of bronchitis it is diminished.

Muscle.—The prolonged contraction produced by veratrine, or barium salts is abolished by potassium salts. They are direct muscular depressants, and depress also the nervous system, especially the brain and spinal cord.

THERAPEUTICS OF POTASH.

External.—Caustic potash is used to destroy lupus, and it was formerly employed to make issues. Care must be taken to limit its action, for it diffuses very rapidly. Liquor potassæ is used to dissolve off the fatty matters, and thoroughly cleanse the skin before operations, and weaker solutions of it are employed to remove the epidermis in certain chronic skin diseases. A 40-per-cent. solution is recommended to remove an in-growing toe nail which is painted with the fluid, and in a few seconds is so softened that much can be scraped off. The procedure is repeated till the nail that remains is sufficiently thin to be removed with a pair of fine scissors. Dilute solutions, acting as sedatives, relieve itching.

Internal.—To obtain the effects of alkalies upon internal organs the bicarbonate, citrate, and acetate of potassium are preferable to potash, for that is apt to irritate the stomach, but it is occasionally used in small doses as a gastric sedative for dyspepsia.

Toxicology, see *Soda*.

3. Potassii Carbonas.—Potassium Carbonate. K_2CO_3 with either one or two molecules of water. *Synonym.*—Salt of tartar.

Source.—Pearlash, which is a product of the lixiviation of wood ashes, is treated with water, which dissolves little but the carbonate of potassium, and the solution is evaporated; or it may be obtained by the interaction of potassium sulphate, calcium carbonate, and carbon.

Characters.—A white, very deliquescent, crystalline powder with a caustic taste, soluble in its own weight of water, insoluble in alcohol.

Twenty grains neutralize 17 *grains of citric acid or* 18 *grains of tartaric acid.*

Impurities.—Sulphates, chlorides.

It is used in preparing Liquor Arsenicalis (as a solvent), Decoctum Aloes Compositum (to dissolve the resin), and Mistura Ferri Composita (carbonate of iron is formed).

Dose, 5 to 20 gr.

Action and Therapeutics of Potassium Carbonate

These are the same as those of potash, but the carbonate is less caustic.

4. Potassii Bicarbonas. — Potassium Bicarbonate. $KHCO_3$.

Source.—Pass carbonic anhydride through a solution of potassium carbonate, and let the bicarbonate crystallize out. $K_2CO_3 + CO_2 + H_2O = 2KHCO_3$.

Characters.—Non-corrosive, non-deliquescent, colourless monoclinic prisms. Taste mildly alkaline. *Solubility.*—1 in 4 of water.

Twenty grains neutralize 14 *grains of citric acid or* 15 *grains of tartaric acid.*

Impurities.—The carbonate.

Dose, 5 to 30 gr.

Action of Potassium Bicarbonate.

The potassium bicarbonate is too feebly caustic to be any use for this purpose. Otherwise its actions are those of potash.

Therapeutics of Potassium Bicarbonate.

Stomach.—Potassium bicarbonate may be given before meals to stimulate the flow of gastric juice, and as it is a gastric sedative, it is useful in painful dyspepsia accompanied by a scanty secretion of gastric juice. It may be taken after meals if too much acid is secreted, and the patient suffers from acid eructations, especially if pain be present also, but it is better treatment to remove the cause of the dyspepsia. It is not a common remedy for dyspepsia, bicarbonate of sodium being usually preferred. It should not be used as an alkali in cases of poisoning by mineral acids, because of the evolution of carbonic acid gas. Bicarbonates are used in preference to carbonates, as the latter are far too strongly alkaline for the stomach. Potash water is often drunk as an effervescing water instead of soda water. It should be a solution (30 gr. to the pint) of potassium bicarbonate in water into which CO_2 gas under a pressure of four atmospheres has been passed.

Blood. — Potassium bicarbonate circulates in the blood as the carbonate. It was formerly much used in rheumatic fever, but is now superseded by salicylates. Probably it did no good. In gout it is given to keep the blood thoroughly alkaline, and thus to dissolve the uric acid which is in excess in the plasma. Many of the mineral waters useful for gout owe part of their efficacy to their potassium salts. It is believed to be hæmatinic : that is to say, it is thought to increase the amount of hæmoglobin ; but as for this purpose it is usually given with iron, its hæmatinic power has not yet been proved.

Kidneys.—It is not much used for its diuretic effect and its alkalizing power over the urine, as the vegetable salts are preferable.

5. Potassii Acetas. — Potassium Acetate. CH_3COOK.

Source.—Add acetic acid in excess to potassium carbonate. Evaporate to dryness and fuse the residue. $K_2CO_3 + 2HC_2H_3O_2 = 2KC_2H_3O_2 + H_2O + CO_2$.

Characters.—White, foliated, very deliquescent, satiny, neutral masses or granular particles of peculiar odour. *Solubility.*—2 in 1 in water.

Impurities.—The carbonate and metallic impurities.

Dose, 10 to 60 gr.

6. Potassii Citras. — Potassium Citrate. $C_3H_4 \cdot OH \cdot (COOK)_3$.

Source.—Neutralize potassium carbonate with a solution of citric acid, and evaporate to dryness. $3K_2CO_3 + 2H_3C_6H_5O_7 = 2K_3C_6H_5O_7 + 3H_2O + 3CO_2$.

Characters.—A white, deliquescent powder. Taste saline, feebly acid. *Solubility.*—10 in 6 of water.

Dose, 10 to 40 gr.

Action of Potassium Citrate and Acetate.

External.—No action. Being neutral they are not even antacid.

Internal.—These are the least irritating to the stomach of all potassium salts; being neutral they have no action on gastric juice. They circulate as the carbonate of potassium. Both are more powerfully **diuretic** than any other potassium salts, and act by directly stimulating the renal cells. They are **diaphoretic**, especially the citrate, but neither of them causes a great increase of the perspiration. How they produce this effect is not certainly known.

THERAPEUTICS OF POTASSIUM CITRATE AND ACETATE.

As neither impairs digestion, they are chiefly used for remote effects.

Blood.—They have been largely given for rheumatic fever, but are now not employed. Both salts are of great value in gout, for they keep in solution the excess of uric acid in the plasma. They are powerfully antiscorbutic, that is to say, they prevent scurvy; but they are not so efficacious as lemon juice, lime juice, and fresh vegetables.

Kidneys.—Although in health the diuresis produced by the citrate and acetate of potassium is slight, and the urea and other solids of the urine are actually decreased, yet clinical experience points clearly to the fact that both these salts are, in chronic Bright's disease, powerful diuretics. They are frequently used in this disease and in feverish conditions, and also to increase the amount of urine, and thus to remove pathological fluids in cases of pleuritic effusion, ascites, &c.

They render the urine **alkaline**, and are much employed for this purpose, having the advantage over other potassium salts that they do not derange digestion. Not only do they prevent the precipitation of uric acid, and thus hinder the formation of **uric acid gravel**, but they will dissolve small uric acid calculi. Sir Wm. Roberts states that to keep the urine at the alkalinity necessary for this purpose, 40 to 60 grains of the acetate or citrate should be dissolved in four ounces of water, and taken every four hours. If more than this is used, harm is done, for an insoluble biurate forms on the surface of the calculus. Owing to the depressing action of potassium salts, they should be used with care in persons suffering from heart disease.

Skin.—Both these salts may be used in slight pyrexia, such as that of a common cold, on account of their diaphoretic properties.

Lungs.—These salts, like the carbonates and bicarbonates, are mild saline expectorants, especially suitable for cases of bronchitis, with viscid, scanty expectoration, as they increase the secretion and lessen the viscidity. The iodide of potassium is, however, still more efficacious.

7. Potassii Sulphas. — Potassium Sulphate. K_2SO_4.

SOURCE.—Occurs native. Also obtained by the interaction of sulphuric acid and potassium chloride or certain other potassium salts.

CHARACTERS.—Hard, colourless, rhombic prisms, terminated by six-sided pyramids. Taste, disagreeable. *Solubility.*—1 in 10 of water.

IMPURITIES.—Other sulphates and chlorides.

Dose, 10 to 40 gr.

It is contained in Pilula Colocynthidis Composita, 1 in 24, Pilula Colocynthidis et Hyoscyami, 1 in 32, Pilula Ipecacuanhæ cum Scilla, 1 in 2, Pulvis Ipecacuanhæ Compositus, 8 in 10 (in the last two merely as a diluent).

8. Potassii Tartras. — Potassium Tartrate. $(CHOH)_2(COOK)_2,H_2O$.

SOURCE.—Neutralize a hot solution of potassium carbonate with acid potassium tartrate. $2KHC_4H_4O_6 + K_2CO_3 = 2K_2C_4H_4O_6 + H_2O + CO_2$.

CHARACTERS.—Small, colourless, deliquescent prisms. *Solubility.*—10 in 8 of water.

IMPURITIES.—Acid tartrate and carbonate of potassium.

Dose, 20 to 60 gr. (diuretic); **2 to 4 dr.** (purgative).

9. Potassii Tartras Acidus.—Acid Potassium Tartrate. $(CHOH)_2COOH.COOK$. *Synonyms.*—Bitartrate of potash; Cream of tartar.

SOURCE.—Obtained by purification from crude tartar (argol) deposited on the sides of wine casks during the fermentation of grape juice.

CHARACTERS.—A fine, white, gritty powder or pieces of a larger crystalline mass. Taste, pleasant, acid. *Solubility.*—1 in 200 of cold water.

IMPURITY.—Calcium tartrate.

Dose, 20 to 60 gr. (diuretic and refrigerant); **2 to 8 dr.** (purgative).

It is contained in Confectio Sulphuris, Pulvis Jalapæ Compositus, and Trochiscus Sulphuris.

ACTION OF POTASSIUM SULPHATE, ACID TARTRATE, AND TARTRATE.

External.—One of these being only slightly acid and the others neutral, they have none of the external caustic or antacid properties of other potassium salts.

Internal.—*Intestines.*—All three salts are typical hydragogue **saline purges**, producing easy, soft, watery motions without griping. They abstract fluid from the blood, and cause it to be poured into the intestine. Their mode of action has already been fully described (see p. 86).

Liver.—The **sulphate** of potassium is a moderate **cholagogue**, slightly increasing the biliary flow.

Kidneys.—The **tartrate** and **acid tartrate** are **diuretics**, because a small amount of them is, in the intestine, converted into a carbonate and absorbed, and this acts directly on the renal cells. Hence they render the **urine alkaline**. But all the sulphate and most of the tartrate and acid tartrate is excreted with the fæces, and if, as seems probable, some is absorbed by the small intestine in the form in which it is taken, it is excreted again into the colon.

THERAPEUTICS OF POTASSIUM ACID TARTRATE, TARTRATE, AND SULPHATE.

Internal.—*Intestines.*—These excellent purgatives are frequently used, especially for habitual sluggishness of the bowels. A dose should be dissolved in a tumbler of warm water, and sipped during dressing. They may be employed to open the bowels in cases, such as dropsy or uræmia, in which we wish to eliminate as much fluid as possible. They should for this purpose be given in a concentrated form, for then a large amount of fluid will be secreted from the intestine to bring the solution of the salt to that degree of dilution at which it will act. Compound jalap powder is also much used for this class of case. The sulphate of potassium having some cholagogue action, is to be preferred when it is believed that the liver is at fault.

Liver.—These salts are often given to those who suffer from gall-stones, although no salts of potassium have any power to dissolve gall-stones, but the sulphate does good as a cholagogue.

Kidneys.—The tartrate and acid tartrate are sometimes used as diuretics in the same class of case as the acetate and citrate.

10. Potassii Nitras.—Potassium Nitrate. KNO_3. *Synonyms.*—Nitre; Saltpetre.

SOURCE.—Purified native saltpetre, or the salt artificially made by the action of sodium nitrite and potassium chloride.

CHARACTERS.—White, striated, six-sided prisms. Taste, cool, saline. *Solubility.*—1 in 4 of water.

IMPURITIES.—Sulphates, chlorides and lime.

Dose, 5 to 20 gr.

ACTION OF POTASSIUM NITRATE.

External.—Nothing noteworthy.

Internal.—*Stomach and Intestines.*—It is liable to cause nausea, vomiting, diarrhœa, symptomatic of the gastritis and enteritis produced by it.

Blood.—Owing to its high diffusion power quickly passes into the blood unchanged. External to the body, nitrates prevent the coagulation of the blood, or dissolve the clot if it be already formed, but it is not known that they have any effect on the blood in the body.

Heart. — Potassium nitrate is a powerful cardiac **depressant**, causing the beats to become feeble and few. Large doses lead to great weakness, fainting, and death.

Kidneys.—Small doses are **diuretic** from their direct action on the renal cells, but large ones are liable to inflame the urinary passages, causing hæmaturia. The drug is excreted unchanged in the urine.

Skin.—Nitrate of potassium is a mild **diaphoretic.**

THERAPEUTICS OF POTASSIUM NITRATE.

Internal.—*Blood.*—On account of its supposed action in preventing the coagulation of the living blood, it has been used in rheumatic fever and many inflammatory conditions, but it is now discarded. Probably, as it is a cardiac depressant, it only does harm.

Kidneys and Skin.—It is sometimes employed as a diuretic and diaphoretic in febrile conditions, but the acetate and the citrate are much preferable.

Asthma.—For the treatment of this disease, blotting paper is soaked in a solution of nitre of about 50 gr. to the fluid ounce of water, six pieces about 1½ inch square are, when dry, successively placed in a jar and lighted one at a time. The patient inhales the fumes. Ringer considers it better to dip the paper also into a solution of chlorate of potash, and to burn a piece large enough to fill a whole room with the fumes. This treatment often relieves.

11. Potassii Chloras. — Potassium Chlorate. $KClO_3$.

SOURCE.—Pass chlorine into water holding lime or magnesia in suspension; treat the liquid with potassium chloride and crystallize the potassium chlorate.

CHARACTERS. — Colourless, monoclinic crystals. Taste, cool. Easily explodes on trituration with many substances, especially sugar, sulphur, tannin, charcoal, and glycerin. *Solubility.*—1 in 16 of cold water.

IMPURITIES.—Calcium chloride and lime.

Dose, 5 to 15 gr.

Preparation.

Trochiscus Potassii Chloratis. 3 gr. in each with a rose basis.

ACTION OF POTASSIUM CHLORATE.

External.—It is easily decomposed by septic tissues, and the nascent oxygen given off acts as a stimulant and antiseptic to them.

Internal.—*Stomach and Intestines.*—Small doses have no effect; poisonous ones produce symptoms similar to those induced by the nitrate.

Blood.—Here also small doses have no effect, but several cases of poisoning show that in large doses chlorate of potassium disintegrates the red corpuscles, and converts hæmoglobin into **methæmoglobin.** The altered blood causes the skin to be cyanotic, it is passed by the urine, which is therefore dark-coloured, and contains granular *débris*, and thus the **urine** is exactly **like** that met with in **paroxysmal hæmoglobinuria.** The liver and spleen are enlarged. There may be jaundice and hæmatemesis, and the marrow of the bones becomes very vascular. Nephritis is induced, the tubules are blocked by the *débris* of the blood, and so the urine is scanty. Death occurs from cardiac weakness or uræmia.

As potassium chlorate easily parts with its oxygen, it gives off some of its oxygen to the tissues while it is circulating in the blood, but much of it is excreted unchanged in the urine and other excretions.

THERAPEUTICS OF POTASSIUM CHLORATE.

This drug is used for stomatitis, tonsillitis, and pharyngitis of all varieties, either as lozenges, gargle (10 gr. to 1 fl. oz. of water or decoction of cinchona), or given to be swallowed in solution, for it is then excreted by the saliva. Its action is therefore always local, as it is beneficial in virtue of the nascent oxygen given off from it. It is especially valuable for ulcerative stomatitis. It has been given to women liable to miscarry.

12. Potassii Bichromas.—Potassium Bichromate. K_2CrO_4,CrO_3.

SOURCE.—Prepared from chrome ironstone.

CHARACTERS.—Large orange-red transparent triclinic crystals. *Solubility.*—1 in 10 of water.

INCOMPATIBLES.—Owing to the ease with which it oxidizes it readily forms explosive compounds. Hence it is best prescribed with kaolin or in capsules.

Dose, $\frac{1}{10}$ to $\frac{1}{5}$ gr., in capsules, or as a pill with kaolin.

ACTION AND THERAPEUTICS OF POTASSIUM BICHROMATE.

Occasionally solutions of it have been taken by mistake. Symptoms of very severe gastro-intestinal inflammation with much collapse have followed. Handling the salt frequently may produce eczema. Lately it has been recommended for dyspepsia and gastric ulcer; it is best given on an empty stomach thrice a day.

13. Potassii Permanganas, *see* Manganese.

14. Potassii Iodidum, *see* Iodine.

15. Potassii Bromidum, *see* Bromine.

16. Potassa Sulphurata, *see* Sulphur.

17. Sapo Mollis, soft soap, is Potassium Oleate *see* Olive Oil.

SODIUM.

Symbol, Na. Atomic weight, 22·88. (Official.)

The metal sodium as met with in commerce. It decomposes water, and must therefore be kept under naphtha.

CHARACTERS.—Well known.

From it is prepared Liquor Sodii Ethylatis.

1. Sodii Carbonas.—Sodium Carbonate. Na_2CO_3 $10H_2O$. *Synonym.*—Soda or washing soda.

SOURCE.—Obtained from sodium chloride either by interaction with ammonium bicarbonate or by its conversion into the sulphate and treating this with carbon and calcium carbonate.

CHARACTERS. — Large oblique rhombic crystals, transparent when fresh, but they soon effloresce, and become white on the surface. Taste, caustic. *Solubility.*—1 in 2 of cold water.

Twenty grains neutralize 9·8 *grains of citric acid or* 10·5 *grains of tartaric acid.*

IMPURITIES.—Sulphates and chlorides.

It is contained in Extractum Ergotæ.

Dose, 5 to 30 gr.

2. Sodii Carbonas Exsiccatus.—Exsiccated Sodium Carbonate. Na_2CO_3. It is nearly anhydrous.

SOURCE.—Sodium carbonate is gently heated till losing water of crystallization it loses 63 per cent. of its weight.

CHARACTERS.—A dry white powder.

It is contained in Pilula Ferri (carbonate of iron is formed).

Dose, 3 to 10 gr.

ACTION AND THERAPEUTICS OF SODIUM CARBONATE AND DRIED CARBONATE.

The same as those of potash, except that they are less caustic.

3. Sodii Bicarbonas. — Sodium Bicarbonate. $NaHCO_3$.

SOURCE.—Made from the carbonate in the same way as potassium bicarbonate is made. Or, by the reaction of sodium chloride and ammonium bicarbonate.

CHARACTERS.—A white powder or small monoclinic crystals. Slightly alkaline; not caustic. *Solubility.*—1 in 11 of cold water.

Twenty grains neutralize 16·7 *grains of citric acid or* 17·8 *grains of tartaric acid.*

IMPURITIES.—The carbonate.

INCOMPATIBLES.—It is decomposed by acids and acid salts; *e.g.* bismuth subnitrate.

Dose, 5 to 30 gr.

Preparation.

Trochiscus Sodii Bicarbonatis.—3 gr. in each with a rose basis.

ACTION OF SODIUM BICARBONATE.

The same as that of potassium bicarbonate, except that it is much more **slowly absorbed** from the gastro-intestinal tract, and like all sodium salts it is only **feebly depressant.** All sodium salts are much less depressant to the cardiac, muscular, and nervous systems, and therefore far less poisonous than potassium salts.

THERAPEUTICS OF SODIUM BICARBONATE.

External.—A lotion of 7 gr. to 1 fl. oz. of water is employed as a sedative to relieve itching.

Internal.—*Stomach.*—Its use in disease is very similar to that of the corresponding salt of potassium, but on account of the two differences just mentioned it is much more frequently given. Hence it is a very common ingredient of medicines designed to relieve dyspepsia, being taken at or a little before meals to increase the flow of the gastric juice, or some time afterwards to neutralize excessive acidity in the cases in which the patient complains of pain, which is relieved by food and comes on about four hours after a meal, or of heartburn and acid eructations. Its value is also partly due to its sedative action on the gastric nerves, whereby it relieves gastric pain, and partly also to its power of liquefying tenacious mucus. A very favourite gastric sedative mixture consists of about 10 grains of sodium bicarbonate, together with 10 grains of bismuth carbonate, suspended in mucilage. A grain or two of sodium bicarbonate, with a grain of powdered rhubarb and some sugar, forms a common stomachic powder for children. Sodium bicarbonate and gentian are also often combined together in stomachic mixtures. Effervescing soda water (made the same way as potash water, p. 118) is a mild gastric sedative. In commerce these waters often contain neither potash nor soda, but even then the carbonic acid gas acts as a sedative.

Sodium bicarbonate is so slowly absorbed, and is, in comparison with potassium salts, so poor a solvent of uric acid, that it is rarely used for any effects it may have after absorption.

TOXICOLOGY.

Poisoning by caustic alkalies is very rare; usually it takes place either by potash, soda, pearlash (potassium carbonate), or soap lees (sodium carbonate). (Both the last are impure. They contain caustic soda or potash.)

Symptoms.—A caustic taste is experienced, and is quickly followed by symptoms of gastro-intestinal irritation, viz. burning heat in the throat, vomiting, diarrhœa, and abdominal pain, together with those of depression, viz. a feeble quick pulse, and a cold and clammy skin. Soon the lips, tongue, and throat become swollen, soft, and red. *Post-mortem appearances.*—The mucous membrane of the mouth, tongue, stomach, and œsophagus, and occasionally that of the larynx, is excoriated, dark, softened, and inflamed.

Treatment.—Wash out the stomach, or give emetics, as zinc sulphate, 20 gr.; or powdered ipecacuanha, 30 gr.; or copper sulphate, 5 gr. in half a pint of tepid water; or vinum ipecacuanhæ, 1 fl. oz.; or mustard, a tablespoonful in half a pint of tepid water; or common salt, 2 tablespoonfuls in half a pint of tepid water; or $\frac{1}{10}$ gr. of apomorphine hydrochloride hypodermically. If none of these are handy, give plenty of warm water and tickle the back of the throat. Then give feeble acids, as vinegar, diluted lemon juice, dilute solution of citric acid, dilute acetic acid. Then demulcents, as oil, linseed tea, or water and white of egg.

4. Sodii Phosphas. — Sodium Phosphate. $Na_2HPO_4,12H_2O$.

Source.—Digest bone ash with sulphuric acid; acid calcium phosphate is formed. $Ca_32PO_4 + 2H_2SO_4 = CaH_42PO_4 + 2CaSO_4$. Filter and add to the solution sodium carbonate. $CaH_42PO_4 + Na_2CO_3 = Na_2HPO_4 + H_2O + CO_2 + CaHPO_4$.

Characters.—Transparent, colourless, efflorescent rhombic prisms. Taste, mildly saline. *Solubility.*—1 in 6 of cold water.

Impurity.—Calcium phosphate.

Dose, 30 to 120 gr. for repeated administration, **¼ to ½ oz.** for single administration.

5. Sodii Phosphas Effervescens.—Effervescing Sodium Phosphate.

Source.—Dry 25 oz. of sodium phosphate till it has lost 60 per cent. of its weight as water. Mix with it sodium bicarbonate, 25 oz.; tartaric acid, 13½ oz.; citric acid, 9 oz. Heat the mixture till it aggregates, and then stir till it assumes a granular form.

Characters.—White granules, which effervesce on the addition of water.

Dose, 60 to 120 gr. for repeated administration, **¼ to ½ oz.** for single administration, in 3 to 6 fl. oz. of water.

6. Sodii Sulphas. — Sodium Sulphate. $Na_2SO_4, 10H_2O$. *Synonym.*—Glauber's salts.

Source.—Obtained by the interaction of sodium chloride and other sodium salts with sulphuric acid.

Characters.—Colourless, monoclinic transparent prisms, efflorescing on exposure to air. Neutral; taste saline. *Solubility.*—3 in 1 of water.

Impurities.—Salts of ammonium and iron.

Dose, 30 to 120 gr. for repeated administration, **¼ to ½ oz.** for single administration.

7. Sodii Sulphas Effervescens.—Effervescing Sodium Sulphate.

Source.—Dry 25 oz. of sodium sulphate till it has lost 56 per cent. of its weight as water. Then mix with it sodium bicarbonate, 25 oz.; tartaric acid, 13½ oz.; citric acid, 9 oz. Heat the mixture till it aggregates, and then stir till it assumes a granular form.

Characters.—White granules, which effervesce on the addition of water.

Dose, 60 to 120 gr. for repeated administration, **¼ to ½ oz.** for single administration in 3 to 6 fl. oz. of water.

8. Soda Tartarata.—Tartarated Soda, Sodium

Potassium Tartrate. $(CHOH)_2COONaCOOK,4H_2O$. *Synonyms.*—Tartrate of sodium and potassium; Rochelle salt.

Source.—Add acid potassium tartrate to a hot solution of sodium carbonate. $2KHC_4H_4O_6 + Na_2CO_3 = 2KNaC_4H_4O_6 + H_2O + CO_2$.

Characters.—Large, colourless, neutral, trimetric prisms. Taste like common salt. *Solubility.*—1 in 2 of cold water.

Impurity.—Acid potassium tartrate.

Dose, 30 to 60 gr. (diuretic); **¼ to ½ oz.** (purgative).

Preparation.

Pulvis Sodæ Tartaratæ Effervescens.—*Synonym.*—Seidlitz powder. Take tartarated soda 120 grains and sodium bicarbonate 40 grains; mix and wrap in blue paper. Tartaric acid 38 grains, wrapped in white paper.

Dose.—Dissolve the powder in the blue paper in nearly half a pint of cold or warm water, and then add that in the white paper, and drink while effervescing.

9. Sodii Citro-Tartras Effervescens.—Effervescent Sodium Citro-tartrate.

Source.—Mix sugar, 15 oz., sodium bicarbonate, 51 oz., citric acid, 18 oz., and tartaric acid, 27 oz. Heat the mixture till it aggregates and assumes a granular form.

Characters.—White deliquescent granules, which effervesce on the addition of water.

Dose, 60 to 120 gr. in 3 to 6 fl. oz. of water.

ACTION OF SODIUM PHOSPHATE, SULPHATE, CITRO-TARTRATE, AND TARTARATED SODA.

Internal.—*Intestines.*—Owing to the slowness with which, compared to the corresponding potassium salts, these sodium salts are absorbed, they pass on into the intestine and there act more efficiently than potassium salts. They are typical saline purgatives, abstracting fluid from the blood until they form a 5 per cent. solution, and then exerting a painless laxative effect, produce a soft motion about two or three hours after administration (*see* p. 86).

The sulphate, which is the most active purgative, and the phosphate are mild cholagogues.

Blood and Kidneys.—Owing to their tardy absorption the action of these salines, as alkalizers of the blood and urine, and as diuretics, is more feeble than that of the corresponding potassium salts.

THERAPEUTICS OF TARTARATED SODA, AND SODIUM CITRO-TARTRATE, SULPHATE, PHOSPHATE.

Internal.—*Intestines.*—These salts of sodium are some of the best purgatives we possess, being especially useful for habitual constipation, and for constipation associated with gout, with hepatic dyspepsia, or with any of the manifestations of an excess of uric acid in the blood or the urine. The best way to take them is to dissolve the required amount in half a tumbler of lukewarm water, and to drink it in successive small draughts while dressing in the morning. The bowels are then usually comfortably opened soon after breakfast. These salts, especially the phosphate and sulphate, are also cholagogues; these two are therefore to be preferred in cases of gall-stones and disease of the liver. The sulphate is the most powerful purgative of all. It is the chief constituent of Carlsbad, Marienbad, Tarasp, and Condal waters, and it occurs associated with much sulphate of magnesium in Æsculap, Hunyadi János, Seidlitz, Pullna, Friedrichshall, Rubinat, and Kissingen waters. A powder consisting of 30 grains of each of sodium sulphate and magnesium sulphate, and a grain of each of sodium chloride and sodium bicarbonate (dose 60 to 240 gr.), forms when dissolved a good imitation of Æsculap, Hunyadi János, and Franz Joseph waters. The phosphate is a milder and less unpleasant purgative than the others; it is often given to children. The effervescing preparations are palatable forms.

If large doses are used the evacuations are very watery, and therefore these drugs are useful to remove fluid in cases of dropsy or ascites (especially if due to disease of the liver). Sufferers from gall stones are undoubtedly benefited by a course of waters containing sulphate of sodium.

10. Sodii Chloridum.—Sodium Chloride. NaCl. *Synonym.*—Common salt.

SOURCE.—Occurs native.

CHARACTERS.—Small, white, crystalline grains or transparent cubic crystals. *Solubility.*—1 in 2¾ of cold water.

Dose, 10 to 240 gr.

ACTION OF SODIUM CHLORIDE.

Common salt forms an article of diet with all creatures living on vegetable food, especially if it contains large amounts of potassium, but is not used either by carnivorous animals or by tribes living solely on flesh. The importance of it is seen in the long distances herbivorous animals will wander to salt-licks, and by the fact that tribes living on vegetables will go to war for the possession of it. Bunge's explanation of this desire for salt is as follows: Blood plasma contains much sodium chloride, vegetable foods contain a large amount of potassium salts; when, therefore, these salts of potassium reach the blood, potassium chloride and the sodium salt of the acid which was combined with the potassium are formed. This and the potassium chloride are excreted by the kidneys, and the blood loses its sodium chloride, which loss is therefore made up by taking sodium chloride with the food. The deprival of salt leads to general weakness, œdema, and anæmia, a series of symptoms often seen in France before the repeal of the salt tax.

Quantities of a tablespoonful and upwards act as an emetic, and may also purge. Rectal injections of solutions of salt are used as an anthelmintic fo the *Oxyuris vermicularis*.

THERAPEUTICS OF SODIUM CHLORIDE.

It is occasionally used as an emetic, also as an anthelmintic. Bathing in sea water acts as a mild general stimulant.

11. Liquor Sodii Ethylatis. — Solution of Sodium Ethylate. C_2H_5ONa.

SOURCE.—Dissolve sodium 22 gr. in absolute alcohol 1 fl. oz. $Na + C_2H_5OH = NaC_2H_5O + H$.

CHARACTERS.—A clear syrupy liquid, changing to brown by keeping, hence should be freshly made as wanted. *Strength*, 18 per cent. of the sodium ethylate.

ACTION AND THERAPEUTICS OF SODIUM ETHYLATE.

Used locally as a mild caustic to remove nævi and other growths.

12. Sodii Sulphis. — Sodium Sulphite. Na_2SO_3, $7H_2O$.

SOURCE.—Saturate a solution of sodium carbonate with sulphurous acid gas.

CHARACTERS.—Colourless, transparent, monoclinic prisms. *Solubility*.—1 in 4 of water.

Dose, 5 to 20 gr.

ACTION AND THERAPEUTICS OF SODIUM SULPHITE.

Sodium sulphite is in the stomach decomposed by the acids there, and gives off sulphurous anhydride. It may therefore be given to arrest fermentation. If any remains undecomposed it is absorbed as a sulphite. No other action of this salt is known. It is very rarely given in medicine, but in sufficient doses might produce the effects of sodium sulphate.

13. Sodii Bromidum, *see* Bromine.

14. Sodii Iodidum, *see* Iodine.

15. Sodii Hypophosphis, *see* Phosphorus.

16. Sodii Arsenas, *see* Arsenic.

17. Sodii Sulphocarbolas, *see* Acidum Carbolicum.

18. Liquor Sodæ Chlorinatæ, *see* Chlorine.

19. Sodii Nitris, *see* Nitrites.

20. Sodii Benzoas, *see* Acidum Benzoicum.

21. Sodii Salicylas, *see* Acidum Salicylicum.

22. Borax, Sodium Biborate, *see* Acidum Boricum.

23. Sapo Durus, Hard Soap, is Sodium Oleate.

24. Sapo Animalis, Curd Soap, is chiefly Sodium Stearate.

AMMONIUM.

Symbol, NH_4. Atomic weight, 18. (Not official.)

1. Liquor Ammoniæ Fortis.—Strong Solution of Ammonia. NH_3 (32·5 per cent. dissolved in water).

SOURCE.—Generate ammonia gas by heating ammonium chloride with slaked lime, and pass it into water.

CHARACTERS.—A colourless liquid, of a very pungent odour, and very alkaline. Sp. gr. 0·891.

IMPURITIES.—Ammonium chloride, sulphide and sulphate.

Preparations.

1. Linimentum Camphoræ Ammoniatum.—*Synonym.*—Compound Liniment of Camphor.—Liquor Ammoniæ Fortis, 100; camphor, 50; oil of lavender, 2½; alcohol (90 per cent.) to make 400 parts.

2. Linimentum Hydrargyri, *see* Mercury.

3. Spiritus Ammoniæ Aromaticus, *see* Ammonium Carbonate.

4. Spiritus Ammoniæ Fetidus, *see* Asafetida.

5. Tinctura Guaiaci Ammoniata, *see* Guaiacum.

2. Liquor Ammoniæ.—Solution of Ammonia. NH_3 (10 per cent. dissolved in water).

SOURCE.—Mix strong solution of ammonia, 1 part, and distilled water, 2 parts.

CHARACTERS.—Like but less pungent than the strong solution. Sp. gr. 0·959.

Dose, 10 to 20 m well diluted.

Preparations.

1. **Linimentum Ammoniæ.**—Liquor Ammoniæ, 1; almond oil, 1; olive oil, 2.
2. **Tinctura Ergotæ Ammoniata,** *see* Ergot.
3. **Tinctura Opii Ammoniata,** *see* Opium.
4. **Tinctura Quininæ Ammoniata,** *see* Quinine.
5. **Tinctura Valerianæ Ammoniata,** *see* Valerian.

ACTION OF SOLUTIONS OF AMMONIA.

External.—A solution of ammonia produces **rubefaction** with a sensation of heat, and, if strong, a sensation of pain and burning. If the vapour is confined it causes vesication.

Internal.—*Nose.*—When inhaled, the vapour of ammonia is irritating to the nose and air passages, causing a pungent sensation and sneezing. The eyes and nose water. The **pulse** and **respiration** are reflexly **accelerated.** If very concentrated it produces swelling and inflammation of the nose, glottis, and respiratory tract.

Stomach.—Like other alkalies, given before meals ammonia increases the flow of gastric juice, given after meals it neutralizes it. It dilates the gastric vessels, and produces a feeling of warmth in the epigastrium. It reflexly stimulates the **heart and respiration.**

Blood.—Its action on the blood is not known, but it is supposed to diminish its local liability to clot in cases of thrombosis, and to dissolve clot that is already formed.

Heart.—Ammonia causes a rise of blood-pressure with an increased pulse rate, due probably to stimulation of the accelerator mechanism.

Respiration.—It increases greatly the frequency of **respiration,** probably from stimulation of the respiratory centre in the medulla.

Nervous system.—The brain is unaffected, and the nerves also, except for the tingling produced when a strong solution of ammonia is locally applied. The motor functions of spinal cord are greatly stimulated by large doses, hence the convulsions in animals poisoned by this drug.

Kidneys.—Ammonia and its salts are oxidized in the body, and the nitric acid, uric acid, and urea in the urine are increased, and thus the acidity of this fluid is slightly heightened.

THERAPEUTICS OF SOLUTIONS OF AMMONIA.

External.—The two liniments are used as counter-irritants in numerous conditions, such as chronic joint disease, chronic rheumatism, &c., and they are often rubbed on the chest in bronchitis. Ammonia is a very uncertain vesicant. Weak solutions of it are often applied to the bites produced by insects. Liquor ammoniæ is very valuable when held to the nose of any one who has fainted, for it almost instantly reflexly produces its stimulating effect on the heart and respiration.

Internal.—Ammonia in some form may be given before meals as a gastric stimulant in dyspepsia. Sal volatile is often used for this purpose, and also for its general stimulating effect on the cardiac, respiratory, and spinal systems, especially in sudden collapse from any cause. Ammonia has been injected subcutaneously in cases of snake-bite.

3. Ammonii Carbonas.—Ammonium Carbonate. A variable mixture of ammonium hydrogen carbonate NH_4HCO_3, with ammonium carbamate $NH_4NH_2CO_2$.

SOURCE.—A mixture of ammonium sulphate or chloride and calcium carbonate is subjected to sublimation and resublimation.

CHARACTERS.—Translucent crystalline cakes, volatile, and pungent to the smell. *Solubility.*—1 in 4 of water.

Twenty grains neutralize 26¾ *grains of citric acid or* 28¾ *grains of tartaric acid.*

IMPURITIES.—Sulphates and chlorides.

Dose, 3 to 10 gr. (stimulant or expectorant); **30 gr.** (emetic).

Preparation.

Spiritus Ammoniæ Aromaticus. *Synonym.*—Sal volatile. Ammonium carbonate, 4 oz.; Liquor Ammoniæ Fortis, 8 fl. oz.; volatile oil of nutmeg, 4½ fl. dr.; oil of lemon, 6½ fl. dr.; alcohol (90 per cent.), 6 pints; water, 3 pints. Mix the oils with the alcohol and water. Distil. To the last portion of the distillate add the ammonia and the carbonate. Heat till solution takes place, and then add to the first portion of the distillate. Sp. gr. 0·890.

Dose, 20 to 40 m for repeated, **60 to 90 m** for single administration.

ACTION AND THERAPEUTICS OF AMMONIUM CARBONATE.

The external and internal actions of the carbonate are the same as those of Liquor Ammoniæ. It is not used externally, but Spiritus Ammoniæ Aromaticus is inhaled for its reflex effects, is taken as a **gastric stimulant** and carminative in dyspepsia, and as a **cardiac and general stimulant** in syncope, &c. The carbonate is, in addition, an excellent **expectorant,** stimulating the respiratory movements, and by its general stimulating effect aiding the expulsion of thick mucus. It is most used for bronchitis in children and the aged. It is an **emetic** acting directly on the stomach.

TOXICOLOGY.

Liquor ammoniæ and the carbonate produce symptoms like other alkalies, but are more corrosive. The air-passages are often inflamed, and the inhalation of the vapour has been known to kill from this cause.

Treatment as for other alkalies.

4. Ammonii Chloridum.—Ammonium Chloride. NH_4Cl. *Synonym.*—Sal ammoniac.

Source.—May be formed by neutralizing a crude solution of ammonia or ammonium carbonate with hydrochloric acid.

Characters.—Colourless crystals, volatile. *Solubility.*—1 in 3 of water.

Impurities.—Chiefly tarry matters.

Dose, 5 to 20 gr.

Action of Ammonium Chloride.

Locally applied ammonium chloride increases the secretion of mucous membranes, and to a slight extent it does the same after absorption. It is a feeble cholagogue, diaphoretic, and diuretic.

Therapeutics of Ammonium Chloride.

It is a very favourite remedy for local application, by means of inhalation of the vapour, to increase the secretion of mucus from the pharynx, Eustachian tubes, larynx, trachea, and bronchi in cases of chronic pharyngitis, otitis media, laryngitis, and bronchitis. Many forms of apparatus for its inhalation are in the market. In most of them it is generated by the action of hydrochloric acid on ammonia. It is occasionally given by the mouth either as a cholagogue, gastric stimulant, diaphoretic, or diuretic, but it is too feeble to be recommended, and it is very nasty; the taste may to some extent be concealed by liquorice. It is sometimes useful in chronic bronchitis with much expectoration. Some authorities consider it a specific for neuralgia. It is not a general stimulant.

5. Liquor Ammonii Acetatis.—Solution of Ammonium Acetate. *Synonym.*—Mindererus's spirit.

Source.—Ammonium carbonate 1 oz. is dissolved in water 10 fl. oz. The solution is neutralized with acetic acid, and water is added to make 1 pint.

Incompatibles.—Potash, soda, and their carbonates, acids, lime water, salts of lead and silver. Should be preserved in green glass bottles.

Dose, 2 to 6 fl. dr.

6. Liquor Ammonii Citratis.—Solution of Ammonium Citrate.

SOURCE.—Dissolve 2½ oz. of citric acid in 12½ fl. oz. of water, neutralize with ammonium carbonate and add water to make 1 pint. Preserve in green glass bottles.

Dose, 2 to 6 fl. dr.

ACTION AND THERAPEUTICS OF THE AMMONIUM ACETATE AND CITRATE.

These are mild diaphoretics and diuretics and are used only for these effects. They probably act in both cases either on the secretory cells or the nerves connected with them. They do not irritate the kidneys, but increase both the water and the solids excreted. They are employed in Bright's disease as diuretics, and in febrile conditions as diaphoretics.

7. Ammonii Phosphas.—Ammonium Phosphate. $(NH_4)_2HPO_4$.

SOURCE.—Add a strong solution of ammonia to dilute phosphoric acid. $H_3PO_4 + 2NH_4HO = (NH_4)_2HPO_4 + 2H_2O$.

CHARACTERS.—Transparent colourless prisms. *Solubility.*—1 in 4 of water.

Dose, 5 to 20 gr.

ACTION AND THERAPEUTICS OF AMMONIUM PHOSPHATE.

As its solution is capable of dissolving a considerable amount of sodium urate it has been used for gout, and also to prevent the precipitation of uric acid when there is a tendency to the formation of uric acid calculi.

8. Ammonii Benzoas, *see* Acidum Benzoicum.

9. Ammonii Bromidum, *see* Bromine.

LITHIUM.

Symbol, Li. Atomic weight, 6·97. (Not official.)

1. Lithii Carbonas.—Lithium Carbonate. Li_2CO_3.

SOURCE.—Obtained from native lithium silicates.

CHARACTERS.—A white powder, or minute crystalline grains; alkaline. *Solubility.*—1 in 70 of water.

IMPURITIES.—Lime, alumina.

Dose, 2 to 5 gr.

2. Lithii Citras. — Lithium Citrate. $C_3H_4 \cdot OH(COOLi)_3 4H_2O$.

SOURCE.—Act on lithium carbonate with citric acid.

CHARACTERS.—White, crystalline powder. *Solubility.*—1 in 2 of water.

Dose, 5 to 10 gr.

3. Lithii Citras Effervescens.—Effervescent Lithium Citrate.

SOURCE.—Mix 21 oz. of citric acid and 5 oz. of lithium citrate, add 31 oz. of tartaric acid and 58 oz. of sodium bicarbonate. Triturate, heat at 210° F., when granular dry at 120° F.

Dose, 60 to 120 gr.

ACTION.

These lithium salts closely resemble in their action the corresponding potassium salts, but, as very little lithium is sufficient to form a salt with uric acid, and lithium urate is very soluble, they are more powerful **solvents of uric acid.** They are also more efficacious as **diuretics** and render the **urine** very **alkaline.** Large doses are general depressants like potassium salts.

THERAPEUTICS.

Salts of lithium are much used internally in acute and chronic gout, to promote the elimination of urate of sodium. They are also given as solvents to patients suffering from uric acid gravel and calculus. Those suffering from gravel often derive great benefit. A lotion of the carbonate (4 gr. to 1 fl. oz. of water) applied on lint and covered with gutta percha relieves the pain of gouty inflammation, promotes the healing of gouty ulcers, and aids the disappearance of tophi. Lithium salts should always be freely diluted. The citrate has the advantage of greater solubility. Lithium salicylate (dose 7 to 15 grains) is recommended, as salicylic acid increases the excretion of uric acid.

GROUP III.

METALS OF THE ALKALINE EARTHS.

Calcium, Magnesium, Barium, Cerium, Aluminium.

CALCIUM.

Symbol, Ca. Atomic weight, 39·71. (Not official.)

Calcium Carbonate is pharmacopœial in two forms.

1. Creta Præparata.—Prepared Chalk. $CaCO_3$.

Source.—Chalk freed from impurities by elutriation and drying.

Characters.—White friable pieces or a dull white powder. Insoluble in water.

Incompatibles.—Acids and sulphates.

Dose, 10 to 60 gr.

Preparations.

1. Hydrargyrum cum Cretâ, *see* Hydrargyrum.

2. Mistura Cretæ.—Prepared chalk, 1; tragacanth, $\frac{1}{8}$; sugar, 2; cinnamon water, 32.

Dose, $\frac{1}{2}$ to 1 fl. oz.

3. Pulvis Cretæ Aromaticus.—Prepared chalk, 11; cinnamon, 4; cloves, $1\frac{1}{2}$; cardamom seeds, 1; nutmeg, 3; sugar, 25.

Dose, 10 to 60 gr.

4. Pulvis Cretæ Aromaticus cum Opio, *see* Opium.

2. Calcii Carbonas Præcipitatus.—Precipitated Calcium Carbonate. $CaCO_3$. *Synonym.*—Precipitated chalk.

Source.—Boil together solutions of calcium chloride and sodium carbonate. $CaCl_2 + Na_2CO_3 = CaCO_3 + 2NaCl$.

Characters.—A white crystalline powder insoluble in water.

Impurities.—Chlorides, alumina, and iron.

Incompatibles.—Acids and sulphates.

Dose, 10 to 60 gr.

Contained in Trochiscus Bismuthi Compositus.

Preparation.

Syrupus Calcii Lactophosphatis.—Precipitated calcium carbonate, $2\frac{1}{2}$ oz.; lactic acid, 6 fl. oz.; concentrated phosphoric acid, $4\frac{1}{2}$ fl. oz.; refined sugar, 70 oz.; orange flower water of commerce undiluted, $2\frac{1}{2}$ fl. oz.; distilled water to make 5 pints.

Dose, $\frac{1}{2}$ to 1 fl. dr.

ACTION OF CALCIUM CARBONATE.

External.—It is mildly astringent and helps to dry moist surfaces.

Internal.—*Stomach and Intestines.* — Calcium carbonate is **antacid.** It is a mild but certain **astringent.** How it acts as an astringent is unknown. It is excreted unchanged in the fæces.

Kidneys.—Because certain mineral waters containing bicarbonates and sulphate of calcium, amongst other salts, have been used successfully in cases of urinary gravel and calculi, it has been asserted that these salts are diuretic, and solvent for uric acid, but it is more likely that the beneficial effects of these waters are due merely to the large amount of water drunk; anyhow, there is no proof that it is due to the salts. Such waters are those of Contrexéville and Vittel.

THERAPEUTICS OF CALCIUM CARBONATE.

External.—Prepared chalk forms an excellent dusting powder for moist eczema.

Internal.—*Alimentary canal.*—Because of its mechanical action it is a good tooth powder. Mistura cretæ and Pulvis cretæ aromaticus, particularly the former, are very valuable for checking mild diarrhœa, especially in children.

Kidneys.—There is no doubt that persons passing gravel or urinary calculi, especially if composed of uric acid, are benefited by drinking the waters of Contrexéville and Vittel. They should be taken in quantities of 3 to 6 pints a day and between meals, to avoid the large amount of fluid causing indigestion. At Contrexéville the great bulk is drunk before breakfast.

The Syrupus Calcii Lactophosphatis is with many a favourite preparation for phthisis and other conditions of anæmia and weakness.

3. Calx.—Lime. Calcium oxide. CaO.

SOURCE.—Made by calcining chalk, limestone, or marble to expel carbonic acid gas.

CHARACTERS.—Compact masses of a whitish colour which readily absorb water, and then swell and crack, with great evolution of heat, and fall into a powder (slaked lime).

4. Calcii Hydras.—Calcium Hydroxide. *Synonym.* —Slaked Lime. $Ca(OH)_2$.

SOURCE.—Prepared by the interaction of water and calcium oxide.

CHARACTERS.—A white, strongly alkaline powder. *Solubility.*—1 in 900 of cold water; if sugar be added 1 in 60.

IMPURITIES.—Those of the lime, viz. iron, alumen, silica.

INCOMPATIBLES.—Acids, alkaline and metallic salts, tartar emetic.

Calcii Hydras is used to make Extractum Ipecacuanhæ Liquidum.

Preparations.

1. Liquor Calcis. *Synonyms.*—Aqua calcis, Lime water. Shake up washed calcium hydroxide 2 oz. in distilled water 1 gallon, and siphon off. To be kept in green glass bottles. *Strength*, ½ gr. to 1 fl. oz.

Dose, 1 to 4 fl. oz.

2. Liquor Calcis Saccharatus.—Shake up calcium hydroxide 1 oz. and sugar 2 oz. in water 1 pint, and siphon off. To be kept in green glass bottles. *Strength*, 8 gr. to 1 fl. oz.

Dose, 20 to 60 m.

3. Linimentum Calcis.—Equal parts of lime water and olive oil.

Carron oil is composed of equal parts of lime water and linseed oil.

Liquor calcis is used in preparing Lotio Hydrargyri Flava, and Lotio Hydrargyri Nigra.

ACTION OF LIME AND SLAKED LIME.

External.—Slaked lime is caustic. Lime water is astringent.

Internal.—*Alimentary tract.*—Lime is antacid. It prevents milk from curdling in the stomach. It allays vomiting, and is an antidote for poisoning by mineral acids, oxalic acid, and zinc chloride. It acts as a mild intestinal astringent.

THERAPEUTICS.

External.—Slaked lime, employed as a caustic, is usually mixed with caustic potash, when it forms Vienna paste, used to destroy warts and other small growths. Lime water applied to weeping eczema is especially serviceable if mixed with glycerin. Linimentum Calcis is very valuable for burns.

Internal.—Lime water is much used to mix with milk to prevent its curdling in the stomach, especially when, as is often the case with children, the curds cause vomiting. It is difficult to understand how it acts, for although lime water contains so little lime it is often efficacious. In severe cases of infantile vomiting equal parts of milk and lime water may be ordered. If it is undesirable to dilute the milk so much, the saccharated lime water is an excellent preparation. Lime water will check slight diarrhœa. It is a useful injection for threadworms, for leucorrhœa, and for gleet.

5. Calcii Phosphas. — Calcium Phosphate. $Ca_3(PO_4)_2$. *Synonym.*—Phosphate of lime.

SOURCE.—Dissolve bone ash (impure Calcii Phosphas) in dilute hydrochloric acid; add the liquid to a diluted solution of ammonia. Wash and dry the precipitate. Or it may be made by the interaction of calcium chloride and sodium phosphate.

CHARACTERS.—A light white amorphous powder, insoluble in water.

Dose, 5 to 15 gr.

It is contained in Pulvis Antimonialis, Extractum Euonymi Siccum.

THERAPEUTICS OF CALCIUM PHOSPHATE.

As it forms such an important constituent of bones, and as the bones of animals whose diet contains no lime salts are soft, calcium phosphate has been given for rickets, and for the anæmia and feebleness often seen in young children, but it is not certain that it does any good. It is used as a diluent for powders, as it prevents their agglutination.

6. Calx Sulphurata.—Sulphurated Lime. A mixture containing much calcium sulphate, some carbon, and not much less than 50 per cent. of calcium sulphide CaS.

SOURCE.—Obtained by heating a mixture of calcium sulphate and wood charcoal.

CHARACTERS.—A grey white powder, with a peculiar smell.

Dose, ¼ to 1 gr. in a pill or tabloid.

THERAPEUTICS OF CALX SULPHURATA.

It has been given internally in cases of suppuration, but it probably has no influence on the process. Lately it has been used for various glandular enlargements, and also for inflammatory processes induced by influenza.

7. Calcii Chloridum. — Calcium Chloride, $CaCl_2,2(H_2O)$.

SOURCE.—Obtained by neutralizing hydrochloric acid with calcium carbonate and evaporating.

CHARACTERS.—White masses, having a great affinity for water, and so deliquescent that they cannot be easily weighed. The drug should be kept in solution. Soluble in its own weight of water.

Dose, 5 to 15 gr.

THERAPEUTICS OF CALCIUM CHLORIDE.

Outside the body it increases the rate of coagulation of the blood, and has therefore been recommended for hæmoptysis and other forms of hæmorrhage, and also for aneurism, but it has not been proved to be of much service. It is, however, probably useful in hæmophilia.

It used to be given with the object of reducing enlarged lymphatic glands, but is not now employed.

8. Calx Chlorinata, *see* Chlorine.

9. Calcii Hypophosphis, *see* Phosphorus.

MAGNESIUM.

Symbol, Mg. Atomic weight, 24·18. (Not official.)

1. Magnesii Sulphas. — Magnesium Sulphate. $MgSO_4,7H_2O$. *Synonym.*—Epsom salts.

Source.—It may be obtained from dolomite (native carbonate of calcium and magnesium), or magnesite (native magnesium carbonate), by the action of sulphuric acid. $MgCO_3 + H_2SO_4 = MgSO_4 + H_2O + CO_2$, or by purifying the native sulphate.

Characters.—Minute colourless rhombic prisms very like zinc sulphate, but moister, and of a bitter taste, whilst that of the zinc salt is metallic. *Solubility.*—1 in 1 of cold water.

Incompatibles.—Alkaline carbonates, phosphoric acid, phosphates, lime water, lead acetate, and silver nitrate.

Impurities.—Lime and iron.

Dose, 30 to 120 gr. for repeated administration, **¼ to ½ oz.** for single administration.

Preparation.

Mistura Sennæ Composita. — Magnesium sulphate, 1 oz. in 4 fl. oz. *See* Senna.

2. Magnesii Sulphas Effervescens.—Effervescing Magnesium Sulphate.

Source.—Dry 50 oz. of magnesium sulphate till it has lost 23 per cent. of its weight. Then mix with it sodium bicarbonate, 36 oz.; tartaric acid, 19 oz.; citric acid, 12½ oz.; refined sugar, 10½ oz. Heat the mixture till it aggregates, and stir till it assumes a granular form.

Characters.—White granules which effervesce on the addition of water.

Dose, 60 to 240 gr. for repeated administration; for a single administration **½ to 1 oz.** in 3 to 6 fl. oz. of water.

3. Magnesii Carbonas Ponderosus.—Heavy Magnesium Carbonate. $(MgCo_3)_3,Mg(OH)_2,4H_2O$.

Source.—Mix strong boiling aqueous solutions of magnesium sulphate and sodium carbonate. Evaporate. $4MgSO_4 + 4Na_2CO_3 + H_2O = (MgCO_3)_3,Mg(OH_2)_2 + 4Na_2SO_4 + CO_2$.

Characters.—A white granular powder, feebly soluble in water; 3½ times as heavy as the light carbonate.

Impurities.—Lime, sulphates.

Dose, 5 to 30 gr. for repeated administration, **30 to 60 gr.** for a single dose.

Preparations.

Liquor Magnesii Carbonatis. *Synonym.*—Fluid magnesia. Carbonic acid gas under a pressure of three atmospheres is passed into a mixture of freshly prepared magnesium carbonate and distilled water. It is kept securely corked. *Characters.*—A clear effervescing fluid, containing 10 gr. of the carbonate in 1 fl. oz.

Dose, 1 to 2 fl. oz.

Heavy Magnesium Carbonate is contained in Trochiscus Bismuthi Compositus.

4. Magnesii Carbonas Levis. — Light Magnesium Carbonate. $(MgCO_3)_3,Mg(OH)_2,4H_2O$.

Source.—Made like the heavy carbonate, except that the solutions are mixed cold and boiled after mixture.

Characters.—A very light white powder. Partly amorphous, with slender microscopic prisms intermixed. Very insoluble.

Dose, 5 to 30 gr. for repeated administration; **30 to 60 gr.** for a single dose.

5. Magnesia Ponderosa.—Heavy Magnesia. MgO. *Synonyms.*—Heavy calcined magnesia, Heavy magnesium oxide.

Source.—Heat the heavy carbonate to expel the CO_2.

Characters.—A white powder, very insoluble in water, 3½ times as heavy as the light.

Dose, 5 to 30 gr. for repeated administration; **30 to 60 gr.** for a single dose.

6. Magnesia Levis.—Light Magnesia. MgO. *Synonyms.*—Light calcined magnesia, Light magnesium oxide.

Source.—Heat the light carbonate to expel the CO_2.

Characters.—A light bulky white powder, feebly soluble.

Dose, 5 to 30 gr. for repeated administration; **30 to 60 gr.** for a single dose.

Pulvis Rhei Compositus contains heavy or light magnesia.

Action of Magnesium Salts.

External.—None.

Internal.—*Stomach and Intestines.*—Magnesia and the magnesium carbonate are antacid, acting in many ways like the potassium and sodium alkalies. The carbonic acid given off, if the carbonate has been given, is sedative to the stomach. They are both decomposed by the gastric juice, the chloride, lactate, and bicarbonate of magnesium being formed. These three salts, or the sulphate if that has been taken, act in the intestine as typical **saline purgatives.** The sulphate is most powerful. The mode of action of this group of purgatives has been discussed on p. 86.

Blood and Urine.—Like other alkaline remedies, these magnesium salts increase the alkalinity of the blood, alkalize the urine, help to keep uric acid in solution, and are diuretic. But their action on the blood and urine is feebler than that of salts of potassium and sodium, for they are with difficulty absorbed.

THERAPEUTICS OF MAGNESIUM SALTS.

Internal.—*Stomach.*—Magnesia and the carbonate are mild alkaline remedies, and may be used in the same class of cases as other alkalies. They form insoluble compounds with mineral acids, oxalic acid, and salts of mercury, arsenic, and copper. By alkalizing the gastric contents they hinder the absorption of alkaloids. They are therefore antidotes to all these substances; the objection to them is their bulk. Magnesia is to be preferred, as the carbonate gives off carbonic acid gas. They must be freely given. The sulphate is an antidote to lead and barium salts, forming insoluble sulphates.

Intestines.—The magnesium salts are very common purgatives. Magnesia, the carbonate, and fluid magnesia are excellent for children. The sulphate is one of our best saline purgatives. It is very largely used, especially for the varieties of constipation that are associated with hepatic disorder, gout, or excessive uric acid. Its use is then spread over some time, and it may conveniently be taken as one of the mineral waters which contain it and sodium sulphate (*see* p. 132). A concentrated solution, causing as it does a greatly increased secretion of intestinal fluid, is a useful purge for dropsy or ascites.

Blood and Kidneys.—So little of these salts is absorbed, that they are only to be given for their alkaline effects on the blood and urine in those cases of gout and uric acid gravel in which potassium or sodium salts cannot be borne.

BARIUM.

Symbol, Ba. Atomic weight, 136·4. (Not official.)

Barii Chloridum.—Barium Chloride. $BaCl_2,2H_2O$.

CHARACTERS.—Colourless, translucent tables.

It is in the Appendix of the Pharmacopœia, as an aqueous solution, used for testing, but it may be given internally.

Dose, $\frac{1}{2}$ to 2 gr.

ACTION.

It causes the cardiac contractions to become slower and more forcible, acting like digitalis. The blood-vessels are constricted, and blood-pressure rises. The plain muscular fibres of the intestine may be excited, and then peristalsis is increased. In these respects it resembles ergot as well as digitalis. It acts like veratrine when applied locally to voluntary muscles, prolonging the contraction; but this effect is done away with by the application of potassium salts.

THERAPEUTICS.

It is not often given, but it has been used for mitral insufficiency accompanied by irregularity of the heart, for hæmorrhage, and as a stimulant in atony of the bladder or intestine. Formerly it was given in nervous diseases.

TOXICOLOGY.

Poisonous doses cause salivation, thirst, vomiting, purging, difficulty of breathing, a slow pulse, and, from its action on the spinal cord, paralysis of the limbs. The heart is arrested in systole.

CERIUM.

Symbol, Ce. Atomic weight, 139·2. (Not official.)

Cerii Oxalas.—Cerium Oxalate. $Ce_2(C_2O_4)_3,9H_2O$.

SOURCE.—Precipitate a solution of an oxalate with a soluble salt of cerium.

CHARACTERS.—A white granular powder, insoluble in water.

IMPURITIES.—Lanthanum oxalate, didymium oxalate.

Dose, 2 to 10 gr.

THERAPEUTICS.

It is given empirically for vomiting, especially that of pregnancy, and occasionally with benefit. No physiological action is known.

ALUMINIUM.

Symbol, Al. Atomic weight, 26·9. (Not official.)

1. Alumen.—Alum. A sulphate of aluminium and potassium (potassium alum), $Al_2(SO_4)_3,K_2SO_4,24H_2O$, or a sulphate of aluminium and ammonium (ammonium alum), $Al_2(SO_4)_3,(NH_4)_2SO_4,24H_2O$.

SOURCE.—Made by the combination of aluminium sulphate with potassium sulphate or with ammonium sulphate.

CHARACTERS.—Very acid, regular octahedral crystals, transparent, colourless, and with a sweetish astringent taste. *Solubility.*—1 in 10 of cold water; 1 in 4 of glycerin.

INCOMPATIBLES.—Alkalies, lime, salts of lead, mercury, and iron, tartrates, and tannic acid.

IMPURITIES.—Iron sulphate and silicates.

Dose, 5 to 10 gr.

Preparation.

Glycerinum Aluminis.—Alum, 1; Distilled water, $\frac{3}{8}$; glycerin, 6.

2. Alumen Exsiccatum.—Exsiccated alum.

SOURCE.—Heat potassium alum to not above 400° F. till no more aqueous vapour is given off. It contains 45 per cent. less water than alum.

CHARACTERS.—A white powder or spongy masses. *Solubility.*—Slowly but completely soluble in water.

3. Kaolinum.—Kaolin.

A native aluminium silicate powdered and freed from gritty particles.

CHARACTER.—A soft white powder. *Solubility.*—Neither in water nor dilute acids.

It is contained in Pilula Phosphori.

ACTION OF ALUM.

External.—It has no action on the unbroken skin, but coagulates the albumen of the discharges from ulcers, sores, &c., and thus forms a protecting covering to the parts, and acts as an efficient **astringent.** The albumen in the tissues themselves is coagulated also. This coagulated albumen will compress and occlude the vessels, and thus alum is **hæmostatic.** Dried alum absorbs water, and therefore its solid form is mildly caustic.

Internal.—*Alimentary tract.*—Alum is an excellent astringent for the mouth, stomach, and intestines, and will cause constipation. In large doses it is **emetic,** acting directly on the stomach, and in larger still, irritant and purgative. Most, if not all, is passed by the fæces; probably it has no remote effects on the tissues.

Nervous system.—Given to animals it produces symptoms closely resembling those of bulbar paralysis in man.

THERAPEUTICS OF ALUM AND KAOLIN.

External.—Alum is occasionally used as a caustic to destroy weak exuberant granulations. Kaolin is a good dusting powder. Because of its astringency alum has many uses; it may, for example, be applied to weeping eczematous surfaces, and as an injection or soaked on lint for vulvitis of children. Solutions of it have been used for leucorrhœa and gleet. Ten grains to the fluid ounce of water is a common strength for most purposes. Five grains to the fluid ounce make a good eye wash or a gargle. Strong solutions or powdered alum applied locally stop bleeding, if it is not severe, such as occurs from piles, leech-bites, slight cuts, the gums, and the nose.

Kaolin resists most chemical reagents, and therefore it is used as a basis for making pills of such bodies as phosphorus, silver nitrate, or potassium permanganate, for with them chemical reaction would occur if an ordinary basis were used.

Internal.—*Alimentary canal.*—As a mouth wash or gargle (5—10 gr. to 1 fl. oz.) alum is very valuable in ulcerative stomatitis, in aphthous conditions of the mouth, and in slight pharyngitis or tonsillitis. Glycerinum Aluminis painted on with a camel's-hair brush is excellent for these conditions. If the nose be irrigated with a solution of alum it may remedy a chronic ozæna. It has been found that other astringents are preferable for bleeding from the stomach and for diarrhœa, but a teaspoonful of alum dissolved in simple syrup and given every quarter of an hour till vomiting is produced is an excellent emetic for children, and may be used to produce vomiting in laryngitis and bronchitis, as it is non-depressant. It is a strange fact that in lead colic alum will sometimes open the bowels, probably because, being a sulphate, it precipitates any lead salts as an insoluble sulphate of lead.

GROUP IV.

Plumbum, Argentum, Zincum, Cuprum, Bismuthum.

The pharmacopœial **salts** of these metals are **powerful astringents. Many** of them have some **salts** which are **emetics,** and others which, when applied locally, are **caustic.** Aluminium, which was last considered, would pharmacologically fall into this group.

PLUMBUM.

Lead. Symbol, Pb. Atomic weight, 205·35. (No official.)

1. Plumbi Oxidum.—Lead oxide. PbO. *Synonym.* Litharge.

Source.—Made by roasting lead in air.

Characters.—Pale brick-red heavy scales. Insoluble in water, soluble in nitric and acetic acids.

Impurities.—Copper, iron, carbonates.

Preparation.

Emplastrum Plumbi.—This is LEAD OLEATE, and is sometimes called lead soap. Lead oxide is boiled in water and olive oil (glyceryl oleate). $3PbO + 3H_2O + 2(C_3H_5, 3C_{18}H_{33}O_2) = 3(Pb2C_{18}H_{33}O_2)$, lead oleate, $+ 2(C_3H_5,3OH)$, glycerin.

Emplastrum Plumbi is contained in Emplastra Hydrargyri, Plumbi Iodidi, Resinæ, and Saponis.

2. Plumbi Acetas.—Lead Acetate. $Pb(C_2H_3O_2)_2, 3H_2O$. *Synonym.*—Sugar of lead.

Source.—Dissolve lead oxide or lead carbonate in acetic acid and water.

Characters.—White monoclinic prisms, slightly efflorescent and of a sweet taste. *Solubility.*—10 in 25 of water.

Incompatibles.—Hard water, mineral acids and salts, alkalies, lime water, potassium iodide, vegetable astringents, preparations of opium, and albuminous liquids.

Impurity.—Lead carbonate.

Dose, 1 to 5 gr.

Preparations.

1. Pilula Plumbi cum Opio.—Lead Acetate, 6; opium, 1; syrup of glucose, $\frac{2}{3}$. 1 of opium in 8.

Dose, 2 to 4 gr.

2. Suppositoria Plumbi Composita. — Lead Acetate, 36; opium, 12; oil of theobroma, 132. To make twelve suppositories. 1 gr. of opium in each.

3. Unguentum Plumbi Acetatis. — Lead Acetate, 20 gr.; white paraffin ointment, 1 oz.

Preparations made from the Acetate in which Lead exists as the **Subacetate,** $Pb_2O(C_2H_3O_2)_2$.

1. Liquor Plumbi Subacetatis Fortis. Strong solution of lead subacetate. *Synonym.*—Goulard extract. Lead acetate, 5, and lead oxide, $3\frac{1}{2}$, are boiled together in water, 20. A dense, clear, colourless liquid, sweet astringent taste, alkaline reaction. Sp. gr. 1·275. *Strength,* 24 per cent. of the subacetate,

2. Liquor Plumbi Subacetatis Dilutus. *Synonyms.*—Goulard water, Goulard lotion. Liquor Plumbi Subacetatis, 1; alcohol (90 per cent.), 1; water, 78.

3. Glycerinum Plumbi Subacetatis.—Lead acetate, 5, lead oxide, 3½, glycerin, 20, and water, 12, are boiled together.

4. Unguentum Glycerini Plumbi Subacetatis. — Glycerinum Plumbi Subacetatis, 1, white paraffin ointment, 5.

3. Plumbi Carbonas.—Lead Carbonate or Lead Hydroxy-carbonate. A mixture of carbonate and hydrate. $2(PbCO_3),Pb(OH)_2$. *Synonym.*—White lead.

SOURCE.—Expose lead to the vapour of acetic acid and to air charged with carbonic acid. $6Pb + 6HC_2H_3O_2 + 3O_2 + 2CO_2 = 2(PbCO_3),Pb(OH)_2 + 2H_2O + 3(Pb2C_2H_3O_2)$.

CHARACTERS.—A heavy, soft white powder, insoluble in water.

IMPURITY.—Lime.

Preparation.

Unguentum Plumbi Carbonatis.—1 with 10 of white paraffin ointment.

4. Plumbi Iodidum.—Lead Iodide. PbI_2.

SOURCE.—Mix solutions of lead nitrate or lead acetate and potassium iodide and dry the precipitate.

CHARACTERS.—Heavy bright yellow powder or crystalline scales almost insoluble in water.

Preparations.

1. Emplastrum Plumbi Iodidi.—Lead Iodide, 1; resin, 1; lead plaster, 8.

2. Unguentum Plumbi Iodidi.—1 with 10 of white paraffin ointment.

ACTION OF LEAD SALTS.

External.—The action of lead salts on the unbroken skin, if they have any, is very slight; but when applied to the abraded skin, to sores and to ulcers, they coagulate the albumen of the discharge, thus forming a protective coat; they coagulate the albumen in the tissues themselves; and they directly, not reflexly, contract the small vessels; for these three reasons they are **powerfully astringent.** They also soothe pain, and are therefore excellent local sedatives. It is obvious that substances so markedly astringent will be **hæmostatics.** Any salt may be irritant and caustic if enough be used and it is sufficiently concentrated.

Internal.—Lead salts act on mucous membranes precisely as on the broken skin, and are therefore powerfully astringent and hæmostatic to all parts of the alimentary canal, from the mouth downwards. (For other actions *see* Toxicology.)

THERAPEUTICS OF LEAD SALTS.

External.—Lead salts are applied as lotions or ointments in many conditions for which an astringent, sedative effect is desired, as in weeping eczema and many varieties of ulceration. The lotions may be injected in vulvitis, leucorrhœa, gleet, and otorrhœa, but should not be applied for ulceration of the cornea, lest the white precipitate formed should lead to permanent opacity. Their sedative effect is well seen in their use in pruritus, but of course the cause of the itching should if possible be removed. The Liquor Plumbi Subacetatis Fortis is rarely used, as it is strong enough to irritate; the dilute form is that usually employed when a lotion is desired. It is often applied to bruises when the skin is unbroken, but it is doubtful if it is absorbed. The ointment of the glycerinum is an excellent remedy, and a lotion of lead and opium is a favourite preparation. It may be made by mixing 5 gr. of extract of opium with 1 fl. oz. of Liquor Plumbi Subacetatis Dilutus and 1 fl. oz. of water. Diachylon ointment consists of equal parts of lead plaster and soft paraffin melted together.

Internal.—The chief uses of lead salts (the acetate is the only one given internally) are as astringents in severe diarrhœa, such as that of typhoid fever, and as hæmostatics, as in gastric ulcer, or in hæmorrhage from the intestine, especially if severe, as in typhoid fever or tuberculosis. For these purposes the Pilula Plumbi c̄ Opio is very valuable, and the suppositories may be employed for rectal hæmorrhage. Lead salts produce marked constipation. Other drugs are generally preferred, but the subacetate of lead may be used as a gargle, or painted on as the glycerinum when an astringent effect on the mouth or pharynx is desired.

Toxicology.

Acute Lead Poisoning.—As when applied externally, so when taken internally, the salts of lead, if concentrated, are powerful irritants. Cases of acute poisoning are rare. The acetate is most frequently taken. There is a burning, sweetish taste in the mouth, thirst, vomiting, abdominal colic, and usually constipation, but if the bowels are open the fæces are black; the skin is cold, and there is collapse. If the patient live long enough, cramps in the legs, giddiness, torpor, coma, and convulsions are present. *Post mortem.*—The stomach and intestines show signs of irritant poisoning.

Treatment.—Give emetics (see p. 129), or wash out the stomach. Give sodium or magnesium sulphate to form an insoluble sulphate, and to open the bowels. If collapse is present, stimulants and warmth should be used.

Chronic Lead Poisoning.—This is so common that it is fully described in text-books on medicine. It usually, in those who work in lead, occurs because they will not wash their hands before meals, and thus they impregnate their food. Those who work at white-lead factories are very liable to it. It has also occurred in many ways from the impregnation of food and water with lead, especially from the storage of soft water in leaden cisterns and pipes.

Symptoms.—The earliest are constipation and intestinal colic. Lead is certainly absorbed, for it circulates in the blood and is excreted by the bowel and kidneys. It is supposed to be taken up as an albuminate, but it cannot exist in the blood as such, for it would be precipitated by the alkali of that fluid. After absorption it diminishes the amount of hæmoglobin and the number of red blood-corpuscles, and produces a sallow anæmia; it checks the separation of urates from the blood and their excretion by the kidneys, hence gout is very common in those poisoned by lead. As it circulates in the gums, and the lead-impregnated plasma bathes their epithelium, through which some of the sulphur in the food and in the tartar of the teeth has diffused, a lead sulphide is precipitated in the gums, and forms the well-known very dark blue line at the base of the teeth. For the same reason a blue line may occasionally be seen round the anus, and, after death, deposits of pigment in the intestines. Circulating in the nervous system, lead very often produces chronic inflammation of the peripheral nerves, especially those supplying the extensors of the hand, and hence wrist-drop is a common symptom ; but any muscles, and sometimes almost all the muscles of the body, may be paralysed from neuritis. It is noteworthy that the supinator longus usually escapes. The sensory fibres of the nerves are not often affected, hence pain and anæsthesia are rare ; but pains, especially round the joints, may occur. In exceptional cases the anterior cornua of the spinal cord waste, and lead often affects the brain, causing saturnine lunacy, and also convulsions, known as saturnine epilepsy. Inflammation of the optic nerve, or optic neuritis, sometimes occurs, leading to blindness, which, however, may be present without any change in the nerve. The kidneys are often the seat of chronic inflammation; whether this is due to the passage of the lead through them, or to the gout caused by the lead, is an open question. The treatment consists chiefly in avoidance of the source of poisoning. Potassium iodide is often given, as it is supposed to increase the excretion of lead in the urine. This is probably incorrect. Very little lead passes out by the urine ; most leaves the body by the fæces. It is said also to be excreted in the bile, sweat, and milk. For a clinical account of the symptoms and treatment a text-book of medicine must be consulted.

ARGENTUM.

Silver. Symbol, Ag. Atomic weight, 107·11. (Not official.)

1. Argenti Nitras. — Silver Nitrate. $AgNO_3$. *Synonym.*—Lunar caustic.

SOURCE.—Obtained by the interaction of silver and nitric acid.

CHARACTERS.—Colourless, tabular, right rhombic crystals. *Solubility.*—2 in 1 of water. Should be kept in the dark, as light blackens it.

INCOMPATIBLES.—Alkalies and their carbonates, chlorides, acids (except nitric and acetic), potassium iodide, solutions of arsenic, and astringent infusions.

IMPURITIES.—Other nitrates.

Dose, $\frac{1}{4}$ to $\frac{1}{2}$ gr. in a pill with kaolin.

2. Argenti Nitras Induratus.—*Synonym.*—Toughened caustic.

SOURCE.—Fuse together silver nitrate, 19 parts, and potassium nitrate, 1 part, and pour into proper moulds.

CHARACTERS.—White or greyish-white cylindrical rods or cones. Freely soluble in water.

3. Argenti Nitras Mitigatus. — *Synonym.*—Mitigated caustic.

SOURCE.—It is a mixture made by fusing together one part of silver nitrate and two parts of potassium nitrate. The product is poured into moulds.

CHARACTERS.—White or greyish-white rods or cones. Freely soluble in water.

4. Argenti Oxidum.—Silver Oxide. Ag_2O.

SOURCE.—Shake a solution of silver nitrate with lime water. $2AgNO_3 + Ca(OH)_2 = Ag_2O + Ca(NO_3)_2 + H_2O$.

CHARACTERS.—An olive-brown powder, feebly soluble in water.

INCOMPATIBLES.—Chlorides and organic substances, especially creosote, for it rapidly oxidizes them and forms explosive compounds.

IMPURITY.—Metallic silver.

Dose, ½ to 2 gr. in a pill with kaolin.

ACTION OF SILVER SALTS.

External.—The action of silver salts is very like that of lead salts, but they are more powerful. Therefore silver nitrate is much used as a **caustic**, but it does not act deeply; it is consequently an admirable agent when we wish a limited caustic action on any particular part. Lotions of it may be used as **astringents**, but they are not so useful as lead lotions, for they are more irritating and cause pain. Silver salts, like lead salts, are **hæmostatic**, acting in precisely the same way. Weak solutions of the nitrate stimulate to healthier action indolent ulcers and other inflamed surfaces.

Internal.—Silver salts, when locally applied to the mucous membrane of the mouth, act as on the abraded skin. In the stomach the nitrate is decomposed, we do not know what compound is formed,

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but it is said to have no astringent action. Silver is absorbed from the alimentary tract, for its long-continued use leads to a permanent bluish-slate colour of the skin, gums, and internal organs. This colour is due to the deposition of minute granules of metallic silver. Very little is known about its further action. In acute poisoning nervous symptoms, as convulsions, are met with; in the chronic form there is loss of appetite, impaired nutrition, albuminuria, rapid irregular action of the heart, and, after death, general fatty degeneration. Some is passed in the fæces as the sulphide.

THERAPEUTICS OF SILVER SALTS.

External.—Nitrate of silver is much used because it is from its limited action one of the best caustics, and may be employed to destroy warts and exuberant granulations, or to apply to bites; but it must be remembered that it is no use when an extensive or deep action is required. Because of its combination of an irritant stimulating effect with an astringent influence, lotions of it, of generally about 5 gr. to the fluid ounce of water, are of much benefit when applied as a paint to weak ulcers, to bedsores, to the affected parts in chronic pharyngitis or laryngitis, or as an injection in gleet or inflammation of the os uteri. Weaker solutions (2 gr. to 1 fl. oz.) are employed for granular lids and various forms of ophthalmia. Solutions of the nitrate will sometimes relieve pruritus, and may be applied to the red skin of a threatening bedsore; very strong solutions have been recommended as a local application in erysipelas. Tinea tarsi is often treated by the application of solid silver nitrate, and ulcers of the mouth and other parts may be touched with it. It is an excellent hæmostatic for leech-bites. It is also applied to smallpox vesicles to prevent pitting, to boils, and to the uterus in chronic cervical catarrh.

organs of the body. It is well seen in the liver, kidneys, stomach, and muscles, including the heart.

Repeated doses given to animals abolish the glycogenic function of the liver, and puncture of the floor of the fourth ventricle no longer causes glycosuria. In frogs poisoned with arsenic the epidermis peels off very easily. This is due to degeneration of its lower cells, the degeneration proceeding from the lowest layer outwards.

ANTIMONIUM.

Antimony. Symbol, Sb. Atomic weight, 119.
(Not official.)

1. Antimonium Nigrum Purificatum.—Antimonious Sulphide. Sb_2S_3.

Source.—The native sulphide is purified.

Characters.—A greyish-black crystalline powder.

2. Antimonium Sulphuratum.—Sulphurated Antimony. A mixture of antimony sulphides and antimony oxides. Sb_2S_5,Sb_2O_5,Sb_2S_3,Sb_4O_6, and sulphur.

Source.—Boil antimonious sulphide with sublimed sulphur and a solution of soda, and precipitate with sulphuric acid.

Characters.—A dull-red powder, insoluble in water.

Dose, 1 to 2 gr.

Contained (1 part in 4½) in Pilula Hydrargyri Subchloridi Composita.

3. Antimonii Oxidum.—Antimonious Oxide. Sb_4O_6.

Source.—Pour a solution of antimonious chloride into water. The antimonious oxychloride is precipitated. $SbCl_3 + H_2O = SbOCl + 2HCl$. The precipitate is treated with sodium carbonate, and the result washed and dried. $2SbOCl + Na_2CO_3 = Sb_2O_3 + 2NaCl + CO_2$.

Characters.—A greyish-white powder, insoluble in water.

Impurities.—Higher oxides.

Dose, 1 to 2 gr.

Preparation.

Pulvis Antimonialis.—A substitute for "James's powder." Antimonious oxide, 1; calcium phosphate, 2.

Dose, 3 to 6 gr.

4. Antimonium Tartaratum.—Tartarated Antimony, or Potassio-tartrate of Antimony. $(KSbO,C_4H_4O_6)_2, H_2O$. *Synonym.*—Tartar emetic.

SOURCE.—Prepared by setting aside a mixture of antimonious oxide and acid potassium tartrate, made into a paste with a little water until combination has taken place and purifying by crystallization.

CHARACTERS.—Colourless transparent crystals with triangular facets. *Solubility.*—1 in 17 of cold, 1 in 3 of boiling water. The solution is faintly acid.

INCOMPATIBLES.—Gallic and tannic acids, most astringent infusions, alkalies, lead salts.

IMPURITY.—Acid tartrate of potassium.

Dose, $\frac{1}{24}$ to $\frac{1}{8}$ gr. (diaphoretic) ; **$\frac{1}{6}$ to 1 gr.** (cardiac depressant) ; **1 to 2 gr.** (emetic).

Preparation.

Vinum Antimoniale. Tartarated antimony, 40 gr. ; boiling distilled water, 1 fl. oz. ; sherry, 19 fl. oz. *Strength.*—2 gr. to 1 fl. oz.

Dose, 10 to 30 m. ; **2 to 4 fl. dr.** as an emetic.

ACTION OF ANTIMONIAL COMPOUNDS.

External.—Antimonial compounds are powerful external **irritants.** Tartar emetic produces a **pustular eruption** at the point of application.

Internal.—*Alimentary canal.*—All compounds of antimony are powerful **irritants,** internally as well as externally; the action of **tartar emetic** is best known. The first result of swallowing this is **vomiting.** The early acts of vomiting are entirely due to the direct action of the drug on the wall of the stomach, but it is quickly absorbed, and by its action on the medulla it also produces sickness, but this action is slight. It will produce vomiting when injected into the blood, partly by its action on the medulla—for it will act if the stomach is replaced by a bladder—but also because some of it is excreted into the stomach and intestines, and thus the vomiting is continued for some time. In large doses tartar emetic is irritant to the intestine.

Heart.—Antimony acts upon man as upon the lower animals. It is a powerful **cardiac depressant,** diminishing both the frequency and the force of the beat of the heart. Experiments on animals have shown that the final stoppage takes place in diastole, and that the chief action of antimony is that of a direct depressant to the cardiac muscle itself. Of course the cardiac depression causes the arterial pressure to fall, but part of this effect is due to a coincident action upon some portion of the vaso-motor system; the probability being that antimony, paralysing the muscular coat of the arteries, relaxes them.

Respiration.—Respiration is depressed, the movements become weaker, and inspiration is shortened, but expiration is prolonged. Finally, the pauses become very long and the movements very irregular. The cause of this is not known; probably it is very complex.

Nervous and muscular systems.—Here also antimony acts as a **powerful depressant,** especially to the spinal cord, and to a less extent to the brain; hence moderate doses cause a feeling of languor, inaptitude for mental exertion, and sleepiness. Experiments on animals show that after the administration of large doses of antimony reflex movement is soon lost, and that this is due to a depressing effect on the sensory part of the spinal cord. This depressant influence is felt also in the muscles, and hence antimony will relieve spasm, but whether it does so by direct action on the muscles, or by acting on the nervous system, is doubtful.

Temperature.—Moderate doses of antimony have little influence on the temperature, but large doses cause a **considerable fall,** due, no doubt, in the main to the circulatory depression, but also, it is said, to a direct action in decreasing the amount of heat produced.

Excretion.—Antimony is excreted by many channels. We have seen that part of its emetic effect is due to its excretion into the stomach. It passes out by the bronchial mucous membrane increasing the amount of secretion, and thus acting as an **expectorant.** On the skin its action is that of a **diaphoretic.** This is chiefly a secondary result of the depression of the circulation, but it is possibly in part a direct local effect. In frogs the action on the skin is very like that of arsenic, but antimony softens rather than detaches the epidermis, which thus becomes a jelly-like mass. It is excreted in the bile, and aids its flow; therefore it is a **cholagogue.**

In passing through the kidneys it may be slightly diuretic, but this depends upon the amount of perspiration produced by it. If its use is continued for some time it will cause, like arsenic, fatty degeneration, especially of the liver, and abolition of the hepatic glycogenic function.

THERAPEUTICS OF SALTS OF ANTIMONY.

External.—Many years ago an ointment of tartar emetic was commonly applied as a counter-irritant, but it causes much pain, and is now seldom used.

Internal.—*Alimentary canal.*—Tartar emetic is not to be recommended as an emetic, for the action is slow, and the general depression of emetic doses is great. For this reason it should never be given to produce purgation. The only cases in which it is permissible are those in which an emetic is required for laryngitis, bronchitis, or some other acute inflammatory condition of the respiratory tract, for then its depressant action on the circulation may perhaps be beneficial, but usually ipecacuanha is preferable.

Circulation.—Antimony was formerly largely employed, especially in combination with aconite, to reduce the force and frequency of the pulse in all sorts of febrile conditions, but this is now generally thought unnecessary. If it is to be used it is especially indicated in respiratory affections, for then its expectorant effect may be valuable.

Respiration.—It has been very much given for the early stage of acute bronchitis, but certainly it should not be continued after a free secretion of bronchial mucus has been set up by it. After that it is, on account of its depressing influence, an undesirable expectorant.

Nervous and muscular systems.—Its use as a sedative in delirium tremens is now abandoned, and the introduction of chloroform has made it unnecessary to employ tartar emetic to relax muscular spasm in herniæ, dislocations, &c.

Remote effects.—Occasionally it is given in fevers for its diaphoretic influence, and for its slight antipyretic action. Sometimes it is ordered as a cholagogue, but because of its powerful depressant action it is less used as a medicine than formerly.

Toxicology.

Acute Poisoning.—The symptoms are very like those of arsenical poisoning (p. 207). *Post mortem.*—The gastro-intestinal irritation is very similar, but it is not nearly so marked.

Treatment.—Unless the vomiting is very free, apomorphine subcutaneously, or zinc sulphate by the mouth, or the stomach-pump may be used. Also frequent doses of half a drachm of tannic or gallic acid dissolved in water, strong tea or 'coffee, mucilaginous drinks, and stimulants subcutaneously. Hot water bottles and warm blankets may be necessary.

Chronic poisoning is not sufficiently common to call for notice here.

CHROMIUM.

Symbol, Cr. Atomic weight, 51·74. (Not official.)

Acidum Chromicum.—Chromic Acid. Chromic anhydride. CrO_3.

Source.—Prepared from potassium bichromate by the action of sulphuric acid.

Characters.—Crimson acicular crystals, very deliquescent, soluble in water. Readily yields oxygen, and will therefore easily explode. It does so with either glycerin or alcohol.

Preparation.

Liquor Acidi Chromici.—Chromic acid, 1; water, 3.

Action.

External.—In consequence of its oxidizing power chromic acid is a powerful deodorant and disinfectant. It coagulates albumen and oxidizes organic matter, and is therefore a powerful **caustic.**

Internal.—None is known.

Therapeutics.

External.—As a lotion, 1 in 40, or even stronger, chromic acid has been used for its disinfectant properties to wash foul ulcers and sores, and also as a local application for ozæna, gonorrhœa, leucorrhœa, and bad ulceration of the mouth. The pharmacopœial liquor is occasionally used as a caustic to destroy condylomata, &c. For the action of potassium bichromate see p. 126.

The remaining groups of the inorganic drugs are non-metallic.

GROUP VIII.

Containing **Phosphorus** only.

PHOSPHORUS.

Symbol, P. Atomic weight, 30·8. (Official.)

Source.—Obtained from calcium phosphate.

Characters.—A wax-like solid, freely soluble in carbon bisulphide, sparingly soluble in alcohol, ether, and chloroform, 1 in 80 in olive oil or melted fat, insoluble in water; luminous in the dark. Must be kept under water, as it oxidizes and takes fire very easily. Heated with hydrogen it forms red or amorphous phosphorus, which is nonpoisonous.

Dose, $\frac{1}{100}$ to $\frac{1}{20}$ gr., in pill or solution.

Preparations.

1. Oleum Phosphoratum.—1 gr. of phosphorus dissolved at 180° F. in 99 gr. of almond oil, which must first be heated to 300° F. and filtered to remove water and organic matter, which would otherwise oxidize the phosphorus. This preparation is so nasty that it is rarely prescribed. *Strength.*—1 per cent.

Dose, 1 to 5 m.

2. Pilula Phosphori. — Phosphorus, 10 gr.; white beeswax melted, 125 gr.; lard, melted, 125 gr.; kaolin, 115 gr.; carbon bisulphide, 33♏. Place the wax and lard in a warmed mortar, and stir till like cream. Dissolve the phosphorus in the carbon bisulphide, and mix with the melted fats; add the kaolin. Keep the mixture in cold water in a bottle from which light is excluded. When dispensed, every 3 grains of the mixture is incorporated with 1 gr. of gum acacia. This pill contains 2 per cent. of phosphorus. It should be varnished.

Dose, 1 to 2 gr.

ACTION.

The only known action of minute doses of phosphorus is that in animals the spongy tissue in the long and short bones is thickened by the deposition of true bone of normal composition, and the compact tissue is rendered more dense. Elixir Phosphori (Brit. Pharm. Conference)—**dose, 1 to 2 fl. dr.**—is the best fluid preparation. Phosphorus enters the blood as phosphorus, and probably acts as such, not as phosphoric acid. *See* Toxicology.

THERAPEUTICS.

It has been used in osteomalacia, in rickets, and in cases of ununited fracture, but for rickets at least it is a very inferior remedy, and it is probably of little use in medicine.

TOXICOLOGY.

Acute Poisoning.—Phosphorus is often taken, or administered criminally, either as match heads or vermin paste. For the first few hours there are no effects, then the following symptoms of gastro-intestinal irritation set in:—Nausea, abdominal pain, and vomiting; the vomited matters smell of phosphorus and are luminous. There is some general depression. Diarrhœa is rare. The patient may die of collapse, but far more frequently these symptoms all pass off, and he appears quite well. But after three or four days jaundice is noticed, and this soon becomes very deep; there is now great prostration, the liver is enlarged, the abdomen distended, and he complains of intense thirst. Vomiting of altered blood and diarrhœa with bloody stools may be observed, but these two symptoms are not severe. The skin is cold, the pulse feeble and rapid. The urine is scanty, highly coloured, albuminous, bile-stained, and perhaps bloody, and it may contain bile acids and crystals of leucin and tyrosin. Muscular twitchings occur, the patient becomes comatose and dies. *Post mortem.*—Two results are very striking. (1) Fatty degeneration (thus phosphorus resembles arsenic and antimony), affecting principally the liver, in which it is very marked; and if the patient lives long enough there may be a diminution in size of the organ. Fatty degeneration is also found in the muscles, kidneys, and gastro-intestinal tract. (2) Hæmorrhages are seen in many places, and ecchymoses are sometimes very abundant. If they occur in the gastric and intestinal mucous membranes they may give rise to the erroneous belief that evidences of acute gastro-intestinal irritation can be found at death. The symptoms of phosphorus poisoning in many respects resemble those of acute yellow atrophy of the liver.

Treatment.—Thoroughly empty the stomach by a stomach-pump or by washing it out. Give copper sulphate as an emetic (*see* p. 167), three grains every few minutes till vomiting is induced, then every 15 minutes; also half a drachm of oil of turpentine (q.v.) every half-hour. A full dose of a saline purge may be administered. No oils or fat should on any account be given.

Chronic Poisoning.—This, which used to be seen in those who worked among phosphorus fumes, is now of great rarity. The chief symptoms are those of gastro-intestinal irritation and necrosis of the jaw.

1. Calcii Hypophosphis.—Calcium Hypophosphite. $Ca(PH_2O_2)_2$.

Source.—Heat phosphorus with slaked lime and water. $3Ca(HO)_2 + 8P + 6H_2O = 3Ca(PH_2O_2)_2 + 2PH_3$.

Characters.—White pearly crystals, with a bitter nauseous taste. *Solubility.*—1 in 8 of cold water.

Dose, 3 to 10 gr.

2. Sodii Hypophosphis.—Sodium Hypophosphite. $NaPH_2O_2$.

Source.—Add sodium carbonate to a solution of calcium hypophosphite and evaporate. $Ca(PH_2O_2)_2 + Na_2CO_3 = CaCO_3 + 2NaPH_2O_2$.

Characters.—A white granular salt with a bitter taste. *Solubility.*—1 in 1 of water.

Dose, 3 to 10 gr.

Therapeutics of Hypophosphites of Calcium and Sodium.

These drugs have been recommended for phthisis, but although in some cases they appear to have done good there is no satisfactory evidence of their value. Calcium Lactophosphate is described on p. 142.

GROUP IX.

Chlorine, Iodine, Bromine.

These elements, which are chemically so closely allied, are all of them powerful disinfectants and irritants.

CHLORINE.

Symbol, Cl. Atomic weight, 35·19.

This gas is not official under its own name, but it is officially obtained from chlorinated lime and chlorinated soda, and acidum nitro-hydrochloricum dilutum contains free chlorine.

1. Calx Chlorinata.—Chlorinated Lime. $CaCl_2O_2$, $CaCl_2$. *Synonym.*—Bleaching powder. It may be regarded either as a compound of calcium hypochlorite and calcium chloride, or as one of lime and chlorine.

Source.—Pass chlorine gas over slaked lime. $2CaH_2O_2 + 2Cl_2 = CaCl_2O_2,CaCl_2 + 2H_2O$.

Characters.—A dull white powder, smelling of chlorine, which it evolves on addition of an acid or on exposure to air, for it absorbs carbonic acid gas. Contains 33 per cent. of available chlorine.

Preparation.

Liquor Calcis Chlorinatæ.—1 of chlorinated lime shaken up with 10 of water. Yields 3 per cent. of chlorine.

2. Liquor Sodæ Chlorinatæ.—Solution of Chlorinated Soda. $NaCl,NaClO$. *Synonym.*—Labarraque's disinfecting fluid.

Source.—Mix a solution of sodium carbonate with one of chlorinated lime.

Characters.—A colourless liquid with an odour of chlorine. It is a mixture of chloride, hypochlorite, and carbonate of sodium. Contains 2·5 per cent. available chlorine. To be preserved in a cool, dark place.

Dose, 10 to 20 m.

Action of Chlorine.

External.—Chlorine is one of the most powerful **disinfectants** and **deodorizers**. It has a very great affinity for hydrogen, and hence decomposes compounds which contain hydrogen, oxygen generally being set free. Chlorine is a very active and destructive **irritant** to the skin and mucous membranes.

Internal.—It is hardly ever given internally. If it were, it would become converted into chlorides.

Therapeutics of Chlorine.

External.—Chlorine is largely used in the form of chlorinated lime to disinfect privies, drains, urinals,

&c. It may be employed also to disinfect rooms after infectious diseases. All metals or articles, such as fabrics, likely to be bleached, should be covered up or removed; the windows and chimneys should be pasted up. The gas can be evolved from common salt, black oxide of manganese, and sulphuric acid. The door is then shut, and the cracks around it are pasted over with paper. Chlorine water is sometimes employed as a wash for foul ulcers and discharges. The preparation known as Electrozone owes its antiseptic properties to chlorine. It is sea water the alkaline chlorides of which have been converted into alkaline hypochlorites by electrolysis. Its antiseptic strength is about the same as that of Liquor Sodæ Chlorinatæ, for it contains 2½ per cent. of available chlorine.

Internal.—Chlorine is only used internally in the form of a wash for the mouth. The vapour gives rise to great irritation of the respiratory tract, and should never be inhaled.

IODUM.

Iodine. Symbol, I. Atomic weight, 125·9. (Official.)

SOURCE.—Obtained from the ashes of seaweeds and from mineral iodides and iodates.

CHARACTERS.—Rhombic prisms or octahedrons, with a peculiar odour and dark colour, giving a violet vapour on heat. *Solubility.*—1 in 5000 of water; freely in alcohol (90 per cent.), ether, chloroform, a solution of potassium iodide or sodium chloride.

INCOMPATIBLES.—Ammonia, metallic salts, mineral acids, alkaloids.

IMPURITIES.—Cyanogen iodide, iron, water.

Preparations.

1. Liquor Iodi Fortis.—Iodine, 5; potassium iodide, 3; water, 5; alcohol (90 per cent.), 36. *Strength.*—11⅔ per cent. of iodine. This corresponds to Linimentum Iodi, B. P. 1885.

2. Tinctura Iodi.—Iodine, 1; potassium iodide, 1; water, 1; alcohol (90 per cent.), 37. *Strength.*—$2\frac{1}{2}$ per cent. of iodine.

Dose, 2 to 5 m.

3. Unguentum Iodi.—Iodine, 1; potassium iodide, 1; glycerin, 3; lard, 20. *Strength.*—4 per cent. of iodine.

ACTION.

External.—The actions of iodine applied externally are the same as those of chlorine, that is to say, it is powerfully **disinfectant and irritant.** The latter action is the most important. Iodine applied to the skin produces a yellow stain, which can be removed by an alkali or sodium hyposulphite. At the same time it causes a sensation of heat and burning, dilatation of the vessels (rubefaction), some œdematous swelling, and some exudation of leucocytes, to which its energetic absorbent action is probably due. There often is an accumulation of fluid under the epidermis forming a vesicle. Preparations of iodine are rarely used strong enough to produce more powerful irritation than this. The external application of them probably reflexly contracts the vessels of the subjacent organs, and this may explain their use as counter-irritants. If they are too strong, the irritation set up by them will proceed to the formation of pustules, and deep inflammation with scarring. They usually destroy the superficial cuticle, so that after the use of them the skin peels. Iodine may be absorbed from the skin, and the alkalies of the blood serum lead to the formation of sodium iodide and sodium iodate; thus

$$6NaHCO_3 + 3I_2 = 6CO_2 + 3H_2O + 5NaI + NaIO_3.$$

These, when they meet an acid, undergo double decomposition; thus

$$5NaI + NaIO_3 + 3H_2O = 6NaHO + 3I_2.$$

Thus free iodine is formed in the stomach and kidneys, and so if iodine has been applied to too large an area we get gastro-intestinal irritation and vomiting. The same may happen if it is taken by the mouth, and it may cause precisely the same symptoms of iodism as potassium iodide (p. 224). Iodine preparations are **parasiticide** to the various vegetable and animal parasites which infest the skin.

Internal.—Minute doses of the tincture occasionally stop vomiting. The vapour is very irritating to the respiratory passages.

THERAPEUTICS.

External.—Iodine is rarely employed for its antiseptic properties, as chlorine is cheaper. The preparations of iodine are in constant use as irritants and counter-irritants. The ointment, tincture, and liquor are much milder than the liniment, which was official in B. P. 1885, and was too strong for many persons. Preparations of iodine are frequently used as counter-irritants for chronic inflammation of joints, for pleurisy, chilblains, periostitis, and many other purposes. The mild preparations of iodine are applied over chronically inflamed lymphatic glands when the cause of the swelling cannot be removed. A decolorized tincture of iodine is prepared, consisting of iodine dissolved in rectified spirit, and decolorized by a strong solution of ammonia. Its strength is 1 in 40 nearly. It is a Brit. Pharm. Conference preparation, and has the advantage of not staining the skin, but it contains no iodine, for iodide and iodate of ammonium are formed. Therefore it is a much milder irritant than other iodine preparations. Any effect it may have is due to excess of ammonia. For its irritant effect the official tincture may be injected into a hydrocele or a cyst to cause adhesive inflammation, and it has been injected into joints, abscesses, and the pleural cavity after empyema; but in such cases great care must be taken that the inflammation induced is not too severe, and this treatment is now very rarely used, for the cavities being kept antiseptic, heal up without it. The tincture, or, if it can be borne, the liquor, is often used as an antiparasitic for ringworm. Coster's paste, which is sometimes employed for this disease, consists of 120 grains of iodine dissolved in 1 fl. oz. of light oil of wood tar. Morton's fluid, which is used as an injection for spina bifida, consists of iodine 10 grains, potassium iodide 30 grains, glycerin 1 fl. oz.

Internal.—The vapour of iodine is occasionally inhaled for diseases of the lungs, but it probably does more harm than good. One or two minims of the tincture in half an ounce of water are often given, quite empirically, every half-hour in cases of vomiting, and sometimes with distinct benefit.

1. Potassii Iodidum.—Potassium Iodide. KI.

SOURCE.—Dissolve iodine in liquor potassæ. $6I + 6KHO = 5KI + KIO_3 + 3H_2O$. Evaporate and heat the residue with charcoal; the oxygen of the iodate is carried off as carbonic oxide. Dissolve in boiling water, filter, wash, and crystallize. $KIO_3 + 3C = KI + 3CO$.

CHARACTERS.—Whitish opaque cubical crystals having a saline taste, without odour if pure, but often smelling of iodine. *Solubility.*—4 in 3 of water; 1 in 12 of alcohol (90 per cent.); 1 in 3 of glycerin.

INCOMPATIBLES.—Bismuth subnitrate, sweet spirits of nitre, liquorice, preparations containing starch.

IMPURITIES.—Iodates.

Dose, 5 to 20 gr. or more.

Preparations.

1. Linimentum Potassii Iodidi cum Sapone. Potassium iodide, 12; curd soap, 16; glycerin, 8; oil of lemon, 1; water, 80.

2. Unguentum Potassii Iodidi.—Potassium iodide, 50; potassium carbonate, 3; water, 47; benzoated lard, 400.

Potassium iodide is contained as a solvent in all pharmacopœial preparations of iodine.

2. Sodii Iodidum.—Sodium Iodide. NaI.

SOURCE.—Made from a solution of soda, as potassium iodide is made from a solution of potash.

CHARACTERS.—A white, deliquescent, crystalline powder, with a saline taste. Freely soluble in water, glycerin, and alcohol.

Dose, 5 to 20 gr.

ACTION OF POTASSIUM AND SODIUM IODIDES.

External.—They have none. They do not irritate, and they are absorbed by the unbroken skin in very small quantities.

Internal.—There is much uncertainty about the action of iodides, which is not surprising when we remember the powerful chemical affinities of iodine. Binz teaches that they are decomposed in the body by small quantities of nascent oxygen (set free by living protoplasm) acting upon an iodide which is in an acidulated solution, the acid being provided by carbonic acid. Thus

$$KI + H_2O + CO_2 = KHCO_3 + HI$$

and then

$$2HI + O = H_2O + I_2.$$

We have just shown that iodine acts as an absorbent and that it leads to leucocytosis; and that iodides act in virtue of the iodine set free from them in the body is supported by the fact that the older physicians produced the same therapeutic effects by giving iodine internally as we procure with iodides, and that iodine taken internally will produce symptoms of iodism. Potassium iodide replaced iodine in therapeutics because it does not cause the same gastro-intestinal irritation. The beneficial effects of iodides are so very marked in syphilis that in this disease they must have some specific action in addition to their general powers as absorbents. They also have a specific effect on the mammary gland, for they lessen the secretion of milk. In long-continued large doses they cause atrophy of the testicles and breasts. Some believe that they aid the elimination of lead, and this may be due to the fact that albuminate of lead is soluble in solutions of potassium iodide. Occasionally considerable general depression is produced by large doses of potassium iodide, but this may be due to the potassium and not to the iodine. Iodides are rapidly eliminated by the urine, saliva, sweat, and mucous membranes. When taken in excess they produce a number of symptoms known as Iodism.

Iodism.—The patient complains of heavy pain over the frontal sinus, running at the nose, sore throat, increased secretion of saliva, and an eruption on the skin, consisting of patches of erythema. In rare cases there is albuminuria. The inflammation about the fauces may spread to the gums or down the trachea, setting up laryngitis, tracheitis, and bronchitis. These symptoms have been ascribed to an excessive formation of free iodine formed as mentioned above—and this is supported by the fact that they can be checked by large doses of sodium bicarbonate, which keep the fluids of the body alkaline and thus prevent the formation of free iodine—and also to the decomposition of iodides by nitrites, for minute traces of these are believed to exist in saliva, nasal and bronchial mucus, and sweat, and they will liberate free iodine from potassium iodide. It is stated in support of this view that sulphanilic acid (dose, 60 to 90 gr.), which forms a very stable compound with nitrous acid, will prevent iodism. The susceptibility of people to poisoning by iodides varies very much.

THERAPEUTICS OF POTASSIUM AND SODIUM IODIDES.

The most important use of iodides is for syphilis; their value for the primary and secondary stages is comparatively slight, but they are invaluable for the tertiary stages, as they often cause the rapid absorption of nodes, gummata, and other syphilitic deposits. The pharmacopœial dose may often be exceeded: patients sometimes take two, three, or even four drachms a day. Large doses are especially used in syphilis of the nervous system. Potassium iodide is often prescribed with perchloride of mercury. The biniodide is formed and dissolved in the excess of potassium iodide.

Chronic rheumatoid arthritis is often treated, and sometimes with benefit, by small doses of potassium iodide continued for a long while, but probably iodide of iron is more useful. Gonorrhœal rheumatism is often treated with potassium iodide. It frequently aids the absorption of chronic inflammatory products, even when they are not syphilitic. Therefore certain forms of joint disease, of pleurisy, and of pulmonary consolidation sometimes yield to treatment by this drug. The attempt has been made to cure aneurysms which are inaccessible to surgery by giving potassium iodide for long periods, for it is thought that it aids the coagulation of blood in them; but as at the same time the patient is always kept in bed, it is difficult to say how much of any improvement that may happen to take place is due to the iodide. Occasionally it relieves the pain of aneurysm or angina pectoris. It is a valuable expectorant, and sometimes cures cases of bronchitis when other remedies have failed. Lately, chronic Bright's disease has been largely treated with this drug. Lardaceous disease of the kidneys and other organs is benefited by it. It is recommended for asthma, and in some cases does much good. It is occasionally given to decrease the secretion of milk. Potassium iodide perhaps causes a slightly increased excretion of both lead and mercury if they exist in the body, and it is therefore occasionally given in cases of chronic poisoning by these metals.

Sodium iodide is not so much used, but it probably produces the same effects as the potassium salts. Ammonium iodide may be given if the potassium salt causes depression.

BROMUM.

Bromine. Symbol, Br. Atomic weight, 79·35. (Not official.)

Source.—Obtained from sea water and saline springs.

Characters.—A darkish brown volatile liquid with a strong and disagreeable odour. *Solubility.*—1 in 30 of water.

Impurity.—Iodine.

Action.

Like that of chlorine and iodine. It is rarely used in medicine.

1. Potassii Bromidum.—Potassium Bromide. KBr.

Source.—Made from bromine, liquor potassæ, and charcoal in the same way as potassium iodide.

Characters.—Colourless cubic crystals, readily soluble in water, with a saline taste.

Incompatibles.—Acids, acid salts, metallic salts.

Dose, 5 to 30 gr.

2. Sodii Bromidum.—Sodium Bromide. NaBr.

Source.—Made with caustic soda as potassium bromide is made from caustic potash.

Characters.—A granular white powder in small cubic crystals with a saline taste. *Solubility.*—1 in about 2 of water.

Incompatibles.—Those of potassium bromide.

Dose, 5 to 30 gr.

3. Ammonii Bromidum.—Ammonium Bromide.. NH_4Br.

Source.—Made by neutralizing hydrobromic acid with liquor ammoniæ and crystallizing.

Characters.—Small colourless cubic crystals with a pungent saline taste. *Solubility.*—1 in 1½ of water.

Incompatibles.—Acids, acid salts, and spirit of nitrous ether.

Impurities.—Iodides, free bromine.

Dose, 5 to 30 gr.

ACTION OF BROMIDES.

External.—They have none.

Internal.—*Alimentary canal.*—Solutions of any of these three bromides, frequently painted on the throat, diminish its sensibility. Medicinal doses have no other effect on the alimentary canal. All bromides are quickly converted into **sodium bromide** in the stomach and intestines, and they are readily absorbed.

Nervous system.—Bromides are powerful **depressants to the nervous system.** Thus, if an animal be given large doses of any of them, irritation of the cortical motor areas, which before easily excited movements, fails to do so. Experiments also show that the reflex excitability of the cord is considerably diminished, and that the activity of the sensory mechanism is also impaired, for large doses of bromides given to frogs cause cutaneous anæsthesia. In man at least, not only the cortical motor area, but the brain as a whole is depressed, therefore these drugs are powerful **hypnotics.** It is probable that in addition to the brain and spinal cord the peripheral nerves are depressed, so that bromides are well worthy to be called powerful nervous depressants. The activity of the muscles is also diminished, not only by the action of the drugs on the nervous system, but by their direct action on them.

Circulation.—Here also bromides are depressant; large doses exert a direct paralysing influence on the heart, **lessening the force and the frequency of the beat** and producing stoppage in diastole. They are said to cause vaso-motor spasm, but the evidence of this is very unsatisfactory. Toxic doses produce a fall of temperature; this is probably in some way secondary to the depression of the circulation.

Respiration is slightly depressed by bromides.

Metabolism.—The amount of carbonic acid exhaled is greatly decreased by taking large doses of bromides. The amount of urine is increased; the colouring matters, the sulphur, and the nitrogen in it are increased; but the phosphorus is decreased.

Sexual organs.—If bromides are taken for a long time a failure of sexual vigour is produced, and ultimately there is a great lessening of the sexual appetite. Bromides are therefore anaphrodisiacs.

Elimination.—Bromides are rapidly eliminated by the kidneys, skin, saliva, intestinal mucous membrane, bronchial mucous membrane, and milk.

Bromism.—If bromides are taken for too long a period, a series of symptoms of poisoning, to which the above name has been given, may appear. The earliest of them is a rash, consisting of red papules, chiefly on the face and back, exactly resembling some forms of acne. This is probably the result of the excretion of the bromide by the skin. The next symptoms are a general lowering of the cutaneous sensibility and also of that of the pharynx, then there is diminution of sexual power, the patient becomes low-spirited, easily fatigued, unfit for work, and his intellect is dulled. There may be a little conjunctivitis, and some increased secretion from the bronchi.

Potassium bromide owes its action largely to the bromine in it, but probably also, to a less extent, to the potassium. In man at least, the higher functions of the brain are depressed before the lower, and these again before the spinal. Thus the depression takes place in regular order from above downwards, in the reverse order of the physiological development of the functions, and this is commonly the case with many drugs. (*See* Law of Dissolution, p. 96.)

Those who take bromides habitually find themselves unable to sleep without them, and their intellect becomes obscured. These bad effects are intensified by the fact that gradually larger doses are required to produce sleep, and thus the unfortunate sufferer becomes more and more a slave to the drug.

THERAPEUTICS OF BROMIDES.

External.—None.

Internal.—*Alimentary canal.* Formerly the back of the throat was painted with a solution of a bromide before a laryngeal examination, but now cocaine is employed for this purpose.

Nervous system.—Because of their depressing effect bromides are largely used for many nervous diseases. They are the most valuable drugs we have for the treatment of epilepsy, acting no doubt by diminishing the excitability of the cerebral cortex. They rarely cure, but often greatly diminish the number of fits. It is impossible to say of any given case whether bromides will do good, therefore they must be tried in all; petit mal is more difficult to influence than grand mal. The next most common use of bromides is as hypnotics. They are most useful when there is no organic cause to explain the insomnia, and therefore they are not employed when pain keeps the patient awake, but are given with great benefit in the insomnia of overwork, worry, or that connected with the climacteric period. The sleep induced is quiet and refreshing, without dreams, and therefore these drugs are often of great value in nightmare, and in the night screaming of children, which may be regarded as allied to nightmare. Also because of their depressant effect on the nervous system they are given in migraine, and often they are the only drugs which do any good for the intense headache of this disease. Large doses, often a drachm at a time, are given in delirium tremens, especially in combination with chloral, and sometimes the patient seems quieter for this treatment. Not only the insomnia, but the other nervous symptoms that are common at the climacteric period may be relieved by bromides. For their depressing power on centres below the cortex they are used, and with good results, in laryngismus stridulus, and have been given in whooping-cough, but the benefit is not marked. Some cases of tetanus have recovered after enormous doses of bromides. Here their value is, no doubt, due to their power of diminishing the reflex function of the spinal cord. Bromides have been given as antidotes for strychnine poisoning. Sometimes they succeed in cases of hysteria and neuralgia, and some varieties of functional disease of the heart are much improved by them.

Sexual functions.—Because of its depressant effect bromide of potassium is given for spermatorrhœa and nymphomania.

The bromides of potassium, sodium, and ammonium probably have, in the main, the same action, but potassium bromide is usually preferred, and the other two are only given when the potassium salt produces considerable cardiac depression.

4. Acidum Hydrobromicum Dilutum.—Diluted Hydrobromic Acid. HBr.

SOURCE.—It is prepared by the distillation of potassium bromide with concentrated phosphoric acid.

CHARACTERS.—A colourless acid liquid. Sp. gr. 1·077. Contains 10 per cent. of hydrogen bromide.

Dose, 15 to 60 m.

ACTION AND THERAPEUTICS.

The action of this acid appears to be the same as that of the bromides of the alkaline metals, but it is very rarely used for the same purposes. It has been employed with occasional success to relieve noises in the ears, and it is said to prevent the symptoms of poisoning by quinine.

Strontium Salts. (Not official.)

The bromide (**dose, 5 to 30 gr.**) is given for epilepsy, and is said to be less depressant than the bromides of sodium and potassium. The lactate (**dose, 5 to 30 gr.**) is said to be beneficial in parenchymatous nephritis. Both salts are easily soluble in water.

GROUP X.

Containing **Sulphur** only.

SULPHUR.

Symbol, S. Atomic weight, 31·8.

Sulphur is official in two forms.

1. Sulphur Sublimatum.—Sublimed Sulphur. *Synonym.*—Flowers of sulphur.

Source.—From crude sulphur or sulphides by sublimation.

Characters.—A greenish-yellow gritty powder.

Impurities.—Sulphurous and sulphuric acids, sulphide of arsenic, earthy matters.

Dose, 20 to 60 gr.

Preparations.

1. Confectio Sulphuris.—Sublimed sulphur, 4; acid potassium tartrate, 1; tragacanth, $\frac{1}{25}$; syrup, 2; tincture of orange, $\frac{1}{2}$; glycerin, $1\frac{1}{2}$.

Dose, 60 to 120 gr.

2. Unguentum Sulphuris.—Sublimed sulphur, 1; benzoated lard, 9.

Sublimed sulphur is contained in Pulvis Glycyrrhizæ Compositus.

2. Sulphur Præcipitatum.—Precipitated Sulphur. *Synonym.*—Milk of sulphur.

Source.—Sulphur is precipitated by hydrochloric acid from a solution of calcium sulphides and thiosulphate, which has been made by boiling together sulphur and lime in water.

Characters.—A greyish-yellow soft powder free from grittiness.

Impurity.—Calcium sulphate, which makes it gritty.

Dose, 20 to 60 gr.

Preparation.

Trochisci Sulphuris.—Precipitated sulphur, 5; potassium acid tartrate, 1; sugar, 8; gum acacia, 1;

tincture of orange, 1; mucilage of gum acacia, 1. To form 1 lozenge, containing 5 gr. of sulphur and 1 gr. of potassium acid tartrate.

ACTION OF SULPHUR.

External.—Sulphur itself has no action on the skin, but some of it is converted into sulphuretted hydrogen, and that is a mild vascular stimulant causing slight dilatation of the vessels and in some persons eczema. It kills the *Sarcoptes hominis*, and is therefore a **parasiticide.**

Internal.—*Alimentary canal.*—It has no effect on the stomach, and most that is taken is passed out in the fæces unaltered. A certain amount is, in the intestine, converted into sulphuretted hydrogen and other sulphides. These cause a **mild laxative** effect, increasing the secretion of intestinal juice, and slightly stimulating the muscular coat, producing soft semi-liquid stools, sometimes accompanied by flatus of sulphuretted hydrogen, which, if in sufficient quantity, makes sulphur an undesirable laxative.

Remote effects.—Sulphur is absorbed as sulphides and sulphuretted hydrogen, which is a powerful poison, decomposing the blood and thus producing symptoms of asphyxia. It also paralyses the whole nervous and muscular systems, but sulphur is never given to man in sufficient doses to produce any remote effects. Patients taking sulphur get rid of some minute portion of it as sulphuretted hydrogen through the kidneys, the milk, the lungs, and skin. The breath occasionally smells of it, and silver ornaments next to the skin may be discoloured.

THERAPEUTICS OF SULPHUR.

External.—Sulphur is commonly used to kill the *Sarcoptes hominis*, and thus to cure scabies. The skin should be well scrubbed with soft soap and hot water to lay open the burrows. Then it is thoroughly rubbed with the ointment. The patient should do this before bedtime, sleep in flannel, and wash the ointment off the next morning. This proceeding repeated three or four times will generally cure the disease. Sulphur ointment was formerly applied as a stimulant to ulcers, and was rubbed in for chronic rheumatism, but these modes of treatment are now rarely used, and their value is doubtful. Mild sulphur preparations are applied for acne.

Internal.—*Alimentary canal.*—Sulphur is a very good laxative, especially for children; as it produces a soft motion but no pain, it is useful for cases of piles or fissure of the anus. Sublimed sulphur is contained in compound liquorice powder, which is an excellent and popular laxative. One or two sulphur lozenges taken at bedtime often secure an easy evacuation of the bowels the next morning in persons liable to slight constipation. These lozenges have been recommended for constipation associated with hepatic disease.

Remote effects.—Sulphur has been administered internally for all sorts of skin diseases, generally without any good result, but occasionally chronic eczema associated with much itching appears to be benefited by it, so that the sulphur lozenge is a suitable laxative for these cases. Sulphur has been also given for bronchitis, for chronic rheumatism, and rheumatic myalgia, but it is very doubtful whether in these diseases there is much relief from this treatment.

Potassa Sulphurata.—Sulphurated Potash. *Synonym.*—Liver of sulphur. A mixture of salts of which the chief are potassium sulphides.

SOURCE.—Heat in a crucible a mixture of sulphur and potassium carbonate.

CHARACTERS.—Dull green solid masses, the freshly broken surfaces of which are liver-coloured.

Calx Sulphurata.—Sulphurated Lime. A mixture containing not less than 50 per cent. of calcium sulphide with calcium sulphate and carbon.

SOURCE.—Heat calcium sulphate with wood charcoal.

CHARACTERS.—A greyish-white powder, smelling of sulphuretted hydrogen.

Dose, $\frac{1}{4}$ to 1 gr.

Sulphuris Iodidum.—Sulphur Iodide. SI.

SOURCE.—Fuse together sublimed sulphur and iodine.

CHARACTERS.—Greyish-black crystalline pieces, smelling strongly of iodine. *Solubility.*—1 in 60 of glycerin; insoluble in water.

Preparation.

Unguentum Sulphuris Iodidi. — Sulphur iodide, 1; glycerin, 1; benzoated lard, 23.

ACTION OF SULPHURATED POTASH, SULPHURATED LIME, AND SULPHUR IODIDE.

External.—These preparations are irritant, and are powerful **parasiticides** for the *Sarcoptes hominis*.

Internal.—Nothing is known of their internal action.

THERAPEUTICS OF SULPHURATED POTASH, SULPHURATED LIME, AND SULPHUR IODIDE.

External.—An ointment of either will cure scabies, and a sulphurated potash ointment (1 in 80) is often used for this purpose in the same way as sulphur ointment. Both drugs have been used for many chronic skin diseases, but now they are not often employed. They appear, however, occasionally to do good to cases of acne indurata. Baths containing sulphides in solution are considered by many to be very useful for chronic rheumatic arthritis and rheumatic myalgia. The famous natural sulphide baths are those of Aix-la-Chapelle, Aix-les-Bains, and there are many others, which will be found described in works on general therapeutics; but as in all of them the water is warm, and warm water is beneficial for chronic rheumatism, and the sulphides exist in infinitesimally small quantities, it is very probable that the benefit is due more to the heat of the water than to its constituents.

Internal.—Sulphides have been given for chronic rheumatism, various skin diseases, and phthisis, but the evidence of the good done is scanty.

GROUP XI.

ACIDS.

Those acids which will be considered here may be divided into two classes.

Class I.—Those which are strongly acid, the more powerfully acid being active caustics. They are **Sulphuric, Nitric, Hydrochloric, Nitro-hydrochloric, Phosphoric, Acetic, Tartaric, Citric,** and **Lactic** acids. **Hydrobromic** acid might be placed here, but it has already been considered (*see* p. 230).

Class II.—Those which, although feebly acid, are powerfully antiseptic. They are **Boric** and **Sulphurous** acids.

Dilute hydrocyanic, carbolic, benzoic, gallic, tannic, oleic, and salicylic acids are not used as acids, and will be considered under other headings.

Arsenious acid and chromic acid are not true acids; they are anhydrides, and have already been considered (*see* pp. 203 and 213). Oxalic acid is in the Appendix to the Pharmacopœia as a test.

CLASS I.

1. Acidum Sulphuricum. — Sulphuric Acid, H_2SO_4.

SOURCE.—Produced by the combustion of sulphur or pyrites, and the oxidation and hydration of the resulting sulphurous anhydride by means of nitrous and aqueous vapours.

CHARACTERS.—A colourless liquid, of an oily consistency, intensely acid and corrosive. Sp. gr. 1·843. Contains 98 per cent. of hydrogen sulphate.

IMPURITIES.—Nitric acid, lead, arsenic.

INCOMPATIBLES.—Alkalies, their carbonates, lead, and calcium salts.

Preparations.

1. Acidum Sulphuricum Dilutum.—Sulphuric acid diluted with distilled water until it has a sp. gr. 1·094, and contains 13·65 per cent. of hydrogen sulphate.

Dose, 5 to 20 m.

It is contained in Infusum Rosæ Acidum.

2. Acidum Sulphuricum Aromaticum.—*Synonym.*—Elixir of vitriol. Sulphuric acid, 3; alcohol (90 per cent.), 29½; spirit of cinnamon, ½; tincture of ginger, 10. Sp. gr. 0·922 to 0·926.

Dose, 5 to 20 m.

It is contained in Infusum Cinchonæ Acidum.

2. Acidum Nitricum.—Nitric Acid. HNO_3.

SOURCE.—Made from potassium nitrate or sodium nitrate by distilling with sulphuric acid.

CHARACTERS.—A colourless, fuming, very acid liquid. Sp. gr. 1·42. Contains 70 per cent. hydrogen nitrate.

IMPURITIES.—Sulphuric acid, nitre, and lower oxides of nitrogen, giving ruddy fumes.

INCOMPATIBLES.—Alcohol, alkalies, carbonates, oxides, iron sulphate, lead acetate.

Preparations.

1. Acidum Nitricum Dilutum.—Nitric acid diluted with distilled water until it has a sp. gr. 1·101, and contains 17·44 per cent. of hydrogen nitrate.

Dose, 5 to 20 m.

2. Acidum Nitro-hydrochloricum Dilutum. Nitric acid, 3; hydrochloric acid, 4; distilled water, 25. Make fourteen days before use. Contains free chlorine, hydrochloric, nitrous, and nitric acids dissolved in water. Sp. gr. 1·07.

Dose, 5 to 20 m.

3. Acidum Hydrochloricum.—Hydrochloric Acid. HCl.

SOURCE.—The fumes produced by the action of sulphuric acid on sodium chloride are dissolved in water.

CHARACTERS.—A colourless, very acid, fuming liquid. Sp. gr. 1·16. Contains 31·79 per cent. of hydrogen chloride.

INCOMPATIBLES.—Lead and silver salts, alkalies and their carbonates.

Preparations.

1. Acidum Hydrochloricum Dilutum.—Hydrochloric acid diluted with distilled water until it has a sp. gr. 1·052, and contains 10·58 per cent. of hydrogen chloride.

Dose, 5 to 20 m.

2. Acidum Nitro-hydrochloricum Dilutum, *see* Nitric Acid.

4. Acidum Phosphoricum Concentratum. Concentrated Phosphoric Acid. H_3PO_4.

SOURCE.—Treat with nitric acid and water the residue left after burning phosphorus in the air.

CHARACTERS.—A colourless syrupy liquid, of a sour taste. Sp. gr. 1·5. Contains 66·3 per cent. of hydrogen orthophosphate.

INCOMPATIBLES.—Calcium preparations, sodium carbonate.

Preparation.

Acidum Phosphoricum Dilutum. — Phosphoric acid, diluted with distilled water until it has a sp. gr. 1·08, and contains 13·8 per cent. of hydrogen orthophosphate.

Dose, 5 to 20 m.

5. Acidum Aceticum.—Acetic Acid. $CH_3{\cdot}COOH$.

SOURCE.—Obtained from wood by destructive distillation and purification, or from ethylic alcohol by oxidation.

CHARACTERS.—A colourless liquid. Sp. gr. 1·044. Contains 33 per cent. of hydrogen acetate.

IMPURITIES.—Lead and copper, sulphuric, hydrochloric, and sulphurous acids.

Preparations.

1. Acidum Aceticum Dilutum.—Acetic acid diluted with distilled water until it has a sp. gr. 1·006, and contains 4·27 per cent. of hydrogen acetate.

Dose, ½ to 2 fl. dr.

2. Oxymel.—Acetic acid, 1 ; water, 1 ; clarified honey, 8.

Dose, 1 to 2 fl. dr.

6. Acidum Aceticum Glaciale. — Glacial Acetic Acid. $CH_3{\cdot}COOH$.

SOURCE.—Distil dry sodium acetate with strong sulphuric acid. $NaC_2H_3O_2 + H_2SO_4 = CH_3{\cdot}COOH + NaHSO_4$.

CHARACTERS.—A colourless very acid liquid, crystallizing below 60° F. Sp. gr. 1·058. Contains 99 per cent. of hydrogen acetate.

7. Acidum Citricum.—Citric Acid, Hydrogen Citrate. $C_3H_4OH(COOH)_3,H_2O$.

SOURCE.—Obtained from the juice of the fruits of various species of Citrus.

CHARACTERS.—Large colourless trimetric prisms, very soluble in water. **35 gr. to 1 fl. oz.** of water make a solution the **same average strength as lemon juice,** and **neutralize 50 gr. of potassium bicarbonate, 42 gr. of sodium bicarbonate,** or **26 gr. of ammonium carbonate.** Citric acid, like tartaric acid, is often used to produce an effervescing mixture with one of the above carbonates, the two solutions being mixed immediately before taking. The carbonic acid gas which causes the effervescence is formed thus:—$3KHCO_3 + H_3C_6H_5O_7 = K_3C_6H_5O_7 + 3CO_2 + 3H_2O$.

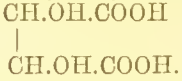
INCOMPATIBLES.—Potassium tartrate, alkaline carbonates, acetates.

IMPURITIES.—Copper, lead, sulphuric and tartaric acids, mineral matters.

Free citric acid is contained in Succus Limonis, Syrupus Limonis.

Dose, 5 to 20 gr.

8. Acidum Tartaricum.—Tartaric Acid, or dextro-rotatory hydrogen tartrate, $C_4H_6O_6$. It may be regarded as dioxysuccinic acid or dihydroxysuccinic acid,



$$\begin{array}{c} CH.OH.COOH \\ | \\ CH.OH.COOH. \end{array}$$

SOURCE.—Prepared from potassium acid tartrate.

CHARACTERS.—Colourless opaque monoclinic prisms, longer than those of citric acid. Very soluble in water. **35 gr. neutralize 46 gr. of potassium bicarbonate, 38 gr. of sodium bicarbonate,** or **24½ gr. of ammonium carbonate.**

INCOMPATIBLES.—Salts of potassium, calcium, mercury, lead, vegetable astringents.

IMPURITIES.—Lead, oxalic acid, lime, and potassium tartrate.

Tartaric acid is contained in Pilula Quininæ Sulphatis.

Dose, 5 to 20 gr.

9. Acidum Lacticum.—Lactic acid, Hydrogen Lactate, $CH_3,CHOH,COOH$.

Source.—It may be made by the action of a special ferment on lactose.

Characters.—A colourless syrupy liquid. Sp. gr. 1·21. Contains 75 per cent. of hydrogen lactate. Mixes well with water, alcohol, and ether.

Impurities.—Mineral acids, sugar, lead, and iron.

Action of Sulphuric, Nitric, Hydrochloric, Phosphoric, Acetic, Citric, Tartaric, and Lactic Acids.

External.—All these acids are powerful **irritants** when applied externally. The feeblest is citric. Its concentrated solution has no action on the sound skin, but is irritant to mucous membranes and abraded surfaces. Tartaric is stronger than citric acid; it will act upon the unabraded skin, and applied to a sore it produces pain, a sensation of burning, and considerable vascular dilatation. The remaining acids are very powerful irritants, therefore even weak dilute solutions of them may produce considerable redness and perhaps vesication, and when the solution is strong they are very energetic **caustics**; sulphuric and phosphoric acids, having a powerful affinity for water, are especially active. Sulphuric acid leaves the carbon untouched, therefore it blackens; nitric stains the skin a deep yellow, it does not redissolve the albumen it precipitates, and it is consequently limited in its area of action; nitro-hydrochloric is very powerful; hydrochloric is the least active of the mineral acids; glacial acetic acid is useful when a limited action is required. All the stronger acids unite with and **coagulate albumen**; hence weak solutions, not strong enough to form a slough, which by its separation may cause bleeding, will, by coagulating the blood and so plugging the vessels, and by coagulating the albumen in the tissues and so constricting the vessels, act as **astringents** and **hæmostatics**. Dilute solutions of acids are cooling to the flushed skin of fever, therefore they are called **refrigerants.**

Internal.—*Mouth.*—All acids have a peculiar taste, and give rise to a feeling of roughness about the teeth. As the saliva is alkaline they **increase the amount secreted,** consequently by keeping the mouth moist they allay thirst.

Stomach.—It is believed that if given during a meal acids will **check** the **flow of gastric juice,** as that is an acid secretion. When the amount of acid secreted by the gastric mucous membrane is deficient, acids taken after a meal, when all that the stomach can secrete has been secreted, aid digestion.

Intestine.—Acids quickly become converted into neutral salts, and are probably absorbed as such. Some, especially **sulphuric (diluted),** preserve in the intestine their **astringent action.** They increase the amount of bile poured into the intestine, and are hence **cholagogues**; this is especially the case with **nitric acid.** Nitro-hydrochloric acid is a very complex compound, as far as is known it possesses the action of mineral acids generally.

Remote effects.—Acids may render the blood less alkaline, but never acid. They do this by combining with some of the alkali of the plasma. They also diminish the carbonic acid in the blood. Phosphoric acid is believed to increase the amount of phosphates in the red blood-corpuscles. The administration of hydrochloric acid will increase the number of red corpuscles in chlorosis, but it does not alter the amount of hæmoglobin. It is probable that in their passage through the liver acids check the formation of urea. The reason for this belief is that all these acids, except citric, acetic, tartaric, and lactic, are excreted in the urine chiefly as ammoniacal salts. Nitric acid is stated to be excreted to a small extent as ammonia, and hence slightly to increase the alkalinity of the urine. Acetic, citric, and tartaric acids are decomposed in the blood, alkaline carbonates being formed, and the alkalinity of the urine is increased. This has already been discussed (*see* p. 120). Lactic acid is either converted into a carbonate of an alkali, or passed out as carbonic acid gas in solution in the urine.

THERAPEUTICS OF SULPHURIC, NITRIC, HYDROCHLORIC, PHOSPHORIC, ACETIC, CITRIC, TARTARIC, AND LACTIC ACIDS.

External.—Nitric acid is more often used as a caustic than the others, for, owing to their great affinity for water, it is difficult to limit the action of sulphuric and phosphoric acids; and the remaining acids are not so powerful as nitric acid. It is employed to destroy warts, condylomata, unhealthy phagedænic sores, cancrum oris, &c. &c. Glacial acetic acid is used for small warts and corns. If this causes pain it may be diluted. Very diluted solutions are rarely employed for their irritant effects; at some bathing establishments acid baths are used, but it is not proved that they do any good. Any well-diluted acid, especially sulphuric, may be applied to check slight bleeding, as that of leech-bites, piles, &c. Vinegar can always be obtained; even it should be diluted. In fever the skin is often bathed with vinegar as a refrigerant, and very dilute sulphuric acid is used as a local astringent in the sweating of phthisis.

Internal.—*Mouth.*—As acids damage the teeth they should be taken through a glass tube. Lemon juice or citric acid itself is often used to stimulate the secretion of saliva, and hence allay the thirst of fever patients. Lemonade is a favourite drink for this purpose. Lactic acid has been strongly recommended to dissolve off the membrane in diphtheria, but there is no evidence that this treatment benefits the patient. Equal parts of lactic acid and water may be applied with a mop, or a spray of a strength of 1 fl. dr. to 1 fl. oz. of water may be employed. Very dilute nitric acid has been used for the same purpose. Lactic acid is often applied with a brush in tuberculosis of the larynx, and in some cases with good results. It is usual to begin with lactic acid 50 per cent., water 25 per cent., and glycerin 25 per cent. The strength of the solution is increased till at last lactic acid alone is used. Other accessible tuberculous ulcers—as those of the tongue and skin—may be treated in the same way.

Stomach and Intestines.—Hydrochloric and to a less extent nitro-hydrochloric acids are of the greatest value to that variety of dyspepsia in which the acidity of the gastric juice is deficient. They should, as already explained, be given some little while after a meal. A very usual stomachic mixture consists of dilute nitro-hydrochloric acid combined with tincture of nux vomica and some other stomachic, as compound tincture of gentian. Lactic acid has been used for the same purpose. Acids will often alleviate that form of indigestion in which the patient complains of acid eructations and heartburn. For this purpose they should be given during a meal or before it. They then check the excessive secretion of acid and restrain fermentation. An acid mixture sometimes benefits the indigestion of pregnancy, and small doses of hydrochloric acid may be prescribed during typhoid and other fevers, because the secretion of this acid is much diminished when the temperature is raised. Vinegar is often drunk to reduce obesity, but it only does so because a long course of any acid will set up a mild gastritis, and thus hinder the digestion and absorption of food. Carbonic acid, taken in an effervescing mixture, is a common and very efficacious gastric sedative, beneficial therefore in painful dyspepsia and in vomiting. Dilute sulphuric acid may be used as a hæmostatic in bleeding from the stomach or intestines, but its action is feeble. It is, however, successful as an astringent in many cases of summer diarrhœa. Nitric and nitro-hydrochloric acids, increasing the amount of bile poured into the intestine, are given, and sometimes with much benefit, when it is considered that dyspepsia is due to disordered function of the liver.

Remote effects.—The remote effects of salts of citric, tartaric, and acetic acids have already been described (p. 120). They are due to the increase in the alkalinity of the blood and the urine. Phosphoric acid is often given to weak, sickly, anæmic children with the view of improving the quality of the red blood-corpuscles, and possibly aiding the growth of bones, but it has not been proved to have any great value. The same may be said of the vegetable acids when employed for scurvy, and of lactic and phosphoric acids when given for diabetes ; indeed, the latter are said to do harm. Lime juice was formerly a popular remedy for acute rheumatism, but it did little if any good. Sulphuric acid is by some said to be anhidrotic in the night sweating of phthisis, and had some reputation as a remote hæmostatic, but it is rarely given now for these purposes. Röhrig found that acids diminished the tracheal secretion, and some physicians find that they diminish the secretions in bronchitis. We thus see that the remote effects of all acids, except citric, tartaric, and acetic, are unimportant.

TOXICOLOGY.

All these acids are severe gastro-intestinal irritants when given in toxic doses. Tartaric, citric, and lactic are very rarely taken as poisons. The symptoms produced by the whole class are severe burning pain extending from the mouth to the stomach, excoriation of the mouth with the formation of sloughs, great difficulty in swallowing, vomiting of dark brown coffee-coloured material and shreds of mucus, intense abdominal pain aggravated by the slightest movement, generally obstinate constipation, but if the bowels are open the motions are dark, from the blood contained in them. Some of the acid generally passes down to the larynx and causes swelling of that organ, and consequently dyspnœa from obstruction to respiration. The patient becomes cold, collapsed, and covered with a cold sweat; his pulse is very feeble, and he suffers from great thirst. *Post mortem.*—The mucous membrane of the mouth and gullet is softened and corroded, and whitish-grey sloughs and hæmorrhages may be seen here and there. The coats of the stomach are softened. It is often contracted, and it may be perforated, the aperture being irregular. If the acid escapes into the peritoneal cavity, it may act on almost any of the abdominal organs. Should the patient have lived long enough, there may be corrosion and inflammation of parts of the small intestine. The mucous membrane of the throat and larynx is inflamed and swollen.

Treatment.—Alkalies should be given at once, *e.g.* soap and water, lime water, magnesia, washing soda; and then demulcents, as milk, white of egg, oil, linseed tea. Do not use the stomach-tube if sulphuric acid has been taken, otherwise wash out the stomach. Morphine may be injected subcutaneously for the pain, and brandy subcutaneously for the collapse.

Class II.

1. Acidum Sulphurosum.—Sulphurous Acid. H_2SO_3.

Source.—Sulphurous anhydride may be prepared by burning sulphur in air or oxygen, or by boiling sulphuric acid with carbon, mercury or copper.

Characters.—A colourless liquid with a sulphurous odour. Sp. gr. 1·025. An aqueous solution containing 6·4 per cent. of hydrogen sulphite, H_2SO_3, and corresponding to 5 per cent. of sulphurous anhydride.

Impurities.—Sulphuric acid, mineral matters.

Dose, ½ to 1 fl. dr. Best given in Mistura Amygdalæ.

Action.

External.—Sulphurous acid is strongly deoxidizing, and as it takes up oxygen so easily from organic bodies, it readily decomposes them, becoming itself converted into sulphuric acid, and hence is irritant, but not violently so, for the amount of sulphuric acid in proportion to the water is slight. It is a **disinfectant and deodorant**, for, in virtue of its property of absorbing oxygen, it destroys micro-organisms and arrests fermentation. When applied to the skin it is a **parasiticide.**

Internal.—It is believed to act as a disinfectant in the stomach and intestines, but it is very doubtful whether enough of it to have any appreciable action in this direction can be safely taken.

THERAPEUTICS.

External.—Sulphurous acid is chiefly used as an antiseptic, disinfectant, and deodorant. Sulphurous anhydride is employed as a disinfectant for a sick room after a patient with an infectious disease has been in it. The chimneys and windows should be stopped up. A quarter to half a pound or more of flowers of sulphur is placed in an earthenware vessel and lighted. The door is shut, and the cracks around it pasted over. The room should be left untouched for six hours. Generally not enough sulphur is burnt for this method to be efficacious. Sulphurous acid (2 fl. dr. to 1 fl. oz. of water) is locally applied to cure ringworm. Foul sores may be washed with it.

Internal.—Sulphurous acid is sometimes given internally with the object of preventing abnormal fermentation in the stomach and intestines in certain varieties of dyspepsia, but there is no clinical proof that it can do this, and it should be remembered that it is possible it may do harm by impeding the action of the normal ferments.

2. Acidum Boricum.—Boric Acid. H_3BO_3. *Synonyms.*—Boracic acid, Hydrogen Borate.

SOURCE.—Native, or made by the action of sulphuric acid on borax.

CHARACTERS.—Colourless, pearly, lamellar crystals, feebly acid. *Solubility.*—1 in 30 of cold water; 1 in 3 of boiling water; 1 in 4 of glycerin; 1 in 30 of alcohol (90 per cent.). The solubility of boric acid is greatly increased by the addition of borax.

Dose, 5 to 15 gr.

Preparations.

1. **Glycerinum Acidi Borici.**—Boric acid, powdered, dissolved in glycerin with the aid of heat. *Strength.*—3 in 10. This is an imitation of Boroglyceride (*see* p. 248).

2. **Unguentum Acidi Borici.**—Boric acid, finely powdered, 1; white paraffin ointment, 9.

3. Borax.—Borax, Sodium Pyroborate. *Synonym.*—Sodium Biborate. $Na_2B_4O_7,10H_2O$.

SOURCE.—Neutralize boric acid with sodium carbonate, or boil native calcium borate with a solution of sodium carbonate. Also found native.

CHARACTERS.—Transparent colourless crystals, alkaline, with a sweetish taste. *Solubility.*—1 in 25 of cold water; 1 in 1 of glycerin; not in alcohol.

Dose, 5 to 20 gr.

Preparations.

1. **Glycerinum Boracis.**—Borax, 1; glycerin, 6.

2. **Mel Boracis.**—Borax, 2; glycerin, 1; clarified honey, 16.

ACTION OF BORIC ACID AND BORAX.

External.—Both boric acid and borax have the power of destroying micro-organisms, and are thus **disinfectant and antiseptic,** but their exact value has not been satisfactorily determined. The action is extremely local. Solutions of boric acid will relieve itching. Neither substance produces any irritation.

Internal.—Borax and boracic acid check the action of saliva on starch, but, if anything, they increase the action of the gastric juice and the pancreatic secretion. Large amounts, however, slightly retard digestion, and still larger are gastro-intestinal irritants. Boric acid is rapidly eliminated in the urine; it is said to increase the urea and the quantity of urine. Large doses diminish the acidity of this fluid. It is also excreted in the saliva, sweat, and fæces, and it is stated in rare cases to cause abortion. In exceptional instances, when large quantities have been applied to raw surfaces or mucous membranes, reduction of temperature, depression of spirits, feeble pulse, ecchymoses, and vomiting have supervened.

Therapeutics of Boric Acid and Borax.

As they do not irritate, both these substances are largely used to keep wounds, ulcers, and sores sweet. The action is so local that they cannot be used to dress cavities. Boracic lint is much employed to dress wounds. It is made by passing lint through a hot saturated solution of boric acid. Boracic cotton wool is made the same way. Lister's boric acid ointment consists of boric acid 1 part, white wax 1 part, paraffin 2 parts, almond oil 2 parts. A saturated solution of boric acid (4 per cent.), or a watery solution of 1 in 40 of the patented preparation boro-glyceride (*see* p. 248), may be employed as an antiseptic wash. Such solutions are used for ozæna, vaginitis, urethritis, fetid perspiration of the feet, and ophthalmia. Colitis is often benefited by washing out the large bowel with a couple of pints of a saturated solution of boric acid ; sometimes tannic acid is added. Lister's ointment, or an ointment of boro-glyceride, may be used for pruritus, sunburn, &c. Powdered boracic acid blown into the ear is very useful in fetid discharges from it. Thompson's fluid (borax, 1 oz. ; glycerin, 2 fl. oz. ; water, 2 fl. oz.), in the proportion of $\frac{1}{2}$ fl. oz. to 4 fl. oz. of warm water, is commonly employed to wash out the bladder in cystitis. The glycerin and the honey of borax are excellent applications for aphthous states of the mouth, especially in children. The following is a good wash for the mouth :—Glycerin of borax, 1 fl. dr. ; tincture of myrrh, 10 ♏ ; water to 1 fl. oz.

Borax has been given in epilepsy, and its use is gaining ground. It is often prescribed with advantage in combination with bromides, but it is decidedly inferior to them, although in exceptional cases it may succeed when they have failed. As it is an antiseptic it has been given internally in typhoid fever and phthisis, but with doubtful benefit. Taken internally it is said to relieve irritability of the bladder. In rare cases its use has caused either psoriasis, a papular eruption especially marked near the elbows, an erythematous rash, or eczema. Nausea, loss of appetite, vomiting, and diarrhœa may be produced. It has no effect on the intelligence. The taste is best covered with syrup of orange peel. Boric acid is not employed internally in medicine.

Boro-glyceride.—(Not official.)

SOURCE.—Heat 92 parts of glycerin with 62 of boric acid.

CHARACTERS.—A tough deliquescent mass, readily soluble in water and alcohol.

ACTION AND THERAPEUTICS.

It is a powerful antiseptic, and has been used as a dressing for wounds (*see* p. 247). The pharmacopœial imitation of it is Glycerinum Acidi Borici (*see* p. 246).

GROUP XII.

CARBON AND ITS COMPOUNDS.

CLASS I.—**Carbon.**

CARBO.

Carbon. Symbol, C. Atomic weight, 11·9.

Carbon is only official as

Carbo Ligni.—Wood Charcoal.

SOURCE.—Wood charred without access of air.

CHARACTERS.—A black powder without odour or taste.

Dose, 60 to 120 gr.

ACTION.

External.—Dry charcoal absorbs gases and condenses them within its pores. It thus absorbs oxygen, and hence has an oxidizing power, parting with the absorbed oxygen to oxidize organic and other substances. Therefore it is **disinfectant and deodorant.** It attracts and oxidizes colouring matters, and consequently decolorizes them.

Internal.—It has no known internal action, for it can only absorb gases when dry, and it is quickly wetted when taken internally. It is passed in the fæces unchanged.

THERAPEUTICS.

External.—Charcoal has been recommended as an antiseptic and deodorant for foul ulcers, &c., but it is of very little use, for the discharges soon moisten it. For the same reason a poultice of it, although some of the charcoal is put on dry, is a bad preparation. Charcoal is used in pharmacy as a decolorizing agent.

Internal.—It has been given as a powder, as lozenges, and as biscuits, with the object of preventing fermentation in the stomach, but it cannot be any use after it is wetted. Garrod has shown that a tablespoonful or larger doses of charcoal frequently repeated, are antidotes against most active vegetable poisons, as opium, nux vomica, and aconite, for charcoal seems to have a special attraction for alkaloids. Animal charcoal is the best form to give as an antidote. Charcoal is used as a tooth powder.

CLASS II.—**Ethylic Alcohol, Amylic Alcohol, Ether,** and **Chloroform.**

We know very little about the action of amylic alcohol, but all the other substances produce local anæsthesia by evaporation. They are rubefacient if their vapour is confined. The stomach, heart, and central nervous system are first stimulated and then depressed by them.

ALCOHOL ETHYLICUM.

Ethylic Alcohol. Ethyl hydroxide. C_2H_5,OH.

Ethyl hydroxide is official in the nine following forms:

1. Alcohol Absolutum. Absolute alcohol (strictly this is an incorrect name, for it may contain 1 per cent. water). Often called "alcohol."

Source.—Remove at least 9 per cent. of water from less strong ethylic alcohol, and then distil.

Characters.—A colourless fluid free from odour. Sp. gr. 0·794 to 0·7969. Contains not less than **99** per cent. *by weight* of **alcohol**, and not more than **1** per cent. **water.** Boils at 173·6° F. Entirely volatilized. For tests, see Spiritus Rectificatus.

Used to make chloroform and Liquor Sodii Ethylatis.

2. Spiritus Rectificatus.—Rectified Spirit. **Ethyl Hydroxide, 90** per cent. *by volume*; **Water, 10** per cent.

Source.—Obtained by distillation of fermented saccharine liquids.

Characters and Tests.—Colourless, transparent, inflammable liquid with a burning taste. Sp. gr. 0·834. No residue when evaporated. Clear when mixed with water (absence of oils and resins). No unpleasant smell when evaporated from filter paper (absence of fusel oil and allied bodies); and it must respond to other tests given in the Pharmacopœia.

Alcohol (90 per cent.) is only slightly stronger than rectified spirit, B. P. 1885, containing 1·35 per cent. more alcohol. On mixing alcohol and water, contraction of volume and rise of temperature occur. When such a mixture is prescribed, the cooled liquid should be employed.

The four official liquids obtained by diluting alcohol (90 per cent.) with distilled water are:—

3. Alcohol (70 per cent. *by volume*) = 100 fl. oz. alcohol (90 per cent.) + 31·05 fl. oz. distilled water.

4. Alcohol (60 per cent. *by volume*) = 100 fl. oz. alcohol (90 per cent.) + 53·65 fl. oz. distilled water.

5. Alcohol (45 per cent. *by volume*) = 100 fl. oz. alcohol (90 per cent.) + 105·34 fl. oz. distilled water.

6. Alcohol (20 per cent. *by volume*) = 100 fl. oz. alcohol (90 per cent.) + 355 8 fl. oz. distilled water.

7. Spiritus Vini Gallici. *Synonym.*—Brandy.

Source.—A liquid distilled from wine.

Characters.—Light sherry colour, peculiar flavour.

Contains not less than **43½** per cent. *by volume* of **ethylic alcohol,** with a volatile oil and several ethers.

Preparation.

Mistura Spiritus Vini Gallici. *Synonym.*—Egg flip. Beat up the yolks of two eggs with half an ounce of sugar. Then add of brandy and cinnamon water, each 4 fl. oz.

Dose, 1 to 2 fl. oz.

8. Vinum Xericum. *Synonym.*—Sherry.

CHARACTERS.—A Spanish wine. Pale yellowish-brown colour. Contains not less than **16** per cent. *by volume* of **ethylic alcohol,** with oils, colouring matters, &c., and water. Used to make all Vina except the two made with orange wine.

9. Vinum Aurantii.—Orange Wine.

SOURCE.—Made by fermentation of a saccharine solution to which the fresh peel of bitter orange is added.

CHARACTERS.—Contains from **10** to **12** per cent. *by volume* of **ethylic alcohol.** Used to make Vinum Ferri Citratis and Vinum Quininæ.

Amount of Ethylic Alcohol by Volume in various important Substances.

Alcohol Absolutum . .	contains	99	per cent.
Alcohol (U.S.P.)	,,	94	,,
Spiritus Rectificatus . .	,,	90	,,
Alcohol Dilutum (U.S.P.) .	,,	64·5	,,
Whisky	,,	51 to 59	,,
Rum, Gin, Strong Liqueurs .	,,	51 to 59	,,
Spiritus Tenuior (Proof Spirit)	,,	57	,,
Spiritus Vini Gallici . .	,,	43 to 57	,,
Port	,,	20 to 30	,,
Vinum Album Fortius (U.S.P.)	,,	23 to 29	,,
Sherry and Madeira . .	,,	16 to 22	,,
Vinum Album (U.S.P.) . .	,,	12 to 14	,,
Champagne	,,	10 to 13	,,
Burgundy	,,	9 to 12	,,
Hock	,,	9 to 12	,,
Claret	,,	8 to 12	,,
Vinum Aurantii . . .	,,	10 to 12	,,
Cider	,,	5 to 9	,,
Strong Ale or Stout . .	,,	5 to 9	,,
Beer and Porter . . .	,,	2 to 5	,,
Koumiss	,,	1 to 3	,,

ACTION OF ALCOHOL.

External.—It is a powerful antiseptic, preventing the formation of and killing putrefactive bacteria. If applied to the skin, alcohol quickly evaporates. It therefore cools the skin, which consequently becomes pale from the contraction of the small vessels; owing to this less sweat is secreted. Alcohol is thus refrigerant, astringent, and anhidrotic. But if evaporation is prevented in any way, such as by a watch-glass or a piece of gutta percha, or the alcohol is rubbed in, it quickly absorbs water from the skin, and thus hardens it. Having passed through the epidermis it dilates the vessels, causes a feeling of warmth, and produces a **rubefacient** effect. It has the power of coagulating albumen, but the coagulum quickly redissolves. It extracts water from all tissues.

Internal.—*Mouth.*—When concentrated alcohol produces a feeling of warmth, or often even a **burning sensation**, in the mouth. If held there for some time the albumen of the superficial tissues is coagulated, and the mucous membrane becomes whitish, congested, and opaque, but this appearance soon disappears, as the coagulum is redissolved by the fluids of the tissues. Directly the alcohol is put in the mouth there is an increased flow of saliva, and the pulse may be quickened; these results are reflex, for they occur before there is time for the alcohol to be absorbed. Alcohol has a slight local anæsthetic effect.

Stomach.—Here also, if the alcohol is sufficiently concentrated, there is a sensation of warmth or even of burning. If only small quantities are given, the gastric vessels dilate, the mucous membrane becomes red, and there is an increased secretion of gastric juice. All this can be seen to happen in cases of gastric fistula. The result of these effects is that the appetite is sharpened, and this explains the custom common with many people of taking a little alcohol immediately before meals, and also the common experience that alcohol taken during meals aids digestion. It also increases the activity of the gastric movements and promotes absorption. Thus there are several ways in which **moderate doses of alcohol may help the digestive process,** and Binz has actually demonstrated, by removing the gastric contents at stated times after a meal, that alcohol aids digestion, and by giving potassium iodide he showed that it increased the rapidity of absorption. In some cases it produces **local anæsthesia** in the stomach, and so it may relieve gastric pain. It is to a slight extent decomposed into aldehyde and acetic acid, and consequently some of the pepsin, peptones, and proteids are precipitated. This hinders digestion, but usually not sufficiently to outdo the aid due to the vascular dilatation, the increased secretion, and the greater movement. The effect of **large doses is very harmful.** The activity of the gastric juice is destroyed, the gastric walls are inflamed, large quantities of mucus are poured out, and if the over-indulgence is continued chronic gastritis ensues, the gastric glands atrophy, and consequently we get the permanent dyspepsia of drunkards.

A single dose of alcohol introduced into the stomach in a concentrated form, *e.g.* neat brandy, immediately produces **important reflex effects.** The heart beats more rapidly and more forcibly, the vessels of the whole body dilate, especially those of the skin ; hence there is a feeling of warmth. The blood-pressure rises. These reflex effects are well seen in the immediate restoration of a fainting person by the ingestion of a single dose of brandy. Dilute alcohol, *e.g.* beer, does not produce them. They are quickly followed by the effects of alcohol upon the circulation due to its presence in the blood after absorption.

Intestines.—Here alcohol has a slight **astringent** effect, and consequently it may check diarrhœa.

Blood.—Alcohol is absorbed more largely by the blood vessels than the lacteals. It first increases and then diminishes the amœboid movements of the white blood-corpuscles. It so acts on the red corpuscles as to prevent oxyhæmoglobin from readily yielding up its oxygen, and so it **diminishes the oxidation of the tissues.** This, in habitual drinkers of large quantities of alcohol, may lead to an imperfect combustion of fat, consequently it accumulates in the tissues, and **obesity,** which is often increased by the amount of saccharine matters alcoholic liquids contain, results. The skin acquires a velvety feeling.

Alcohol is slightly **antipyretic,** lowering the temperature in fever. This is chiefly due to cutaneous vascular dilatation and rapidity of circulation, but also slightly perhaps to general diminished oxidation.

A litre of Rhine wine of average strength produces by its oxidation about as much heat as five or six tablespoonfuls of olive oil. Neither the intake of oxygen nor the output of carbonic acid gas is altered by alcohol, therefore as it has been oxidized in the body it saves the tissues and is a food. Repeated observations have shown the proof of this, for moderate doses of alcohol diminish the output of urea and uric acid 6 or 7 per cent.; and that it is a food is also proved by the fact that the weight of the body may be maintained if a large amount of alcohol is taken, even if the rest of the food is very small in amount.

If only moderate doses are drunk, very little alcohol leaves the body in the urine; with large doses the case is different.

Circulation.—The effects upon the circulation reflexly produced by stimulation of the mouth and stomach have already been mentioned. After alcohol is absorbed it influences the heart markedly.

It **beats more powerfully and more rapidly,** the pulse becomes fuller; these results are due to the peripheral arterial dilatation and to a stimulating effect on the accelerator nerves. The vaso-motor system is acted upon, all the **vessels of the body dilate, especially those of the skin**; therefore, if he previously felt cold, the person who has taken the alcohol feels warm. The **blood-pressure rises,** the increased action of the heart more than compensating for the vascular dilatation. The direct effects of alcohol on the circulation after absorption appear more slowly and last longer, but they are clearly similar to those due to the reflex stimulus from the stomach, and therefore they continue them. The result of the increased circulation through the various organs is that they work to greater advantage; hence the mental faculties are brightened for a time, the muscular strength seems increased, more urine is passed, and the skin perspires. The person who has taken the alcohol, in fact, usually feels generally better for it. This is by no means always so; some persons have a headache or feel very sleepy immediately after alcohol. This is probably because the vessels of the abdomen or skin have dilated so excessively that almost all the blood in the body is in them, and consequently there is very little in the brain. There are many individual peculiarities in the effects of alcohol.

It has been repeatedly proved that these good results are but transitory. The **heart,** although at first stimulated, is **more exhausted after the stimulation** has passed off than it was before. This is true also of all the organs of the body stimulated by the increased circulation induced by alcohol. In many campaigns and arctic expeditions it has been found that although at first the men, after taking alcohol, could do more work, yet soon they felt so tired and exhausted, that on the whole they could do much more without than with the alcohol. **Large doses** of alcohol do not stimulate the heart at all; they **paralyse** it, both reflexly from the stomach and after absorption. Enormous doses poured into the stomach kill almost immediately by reflex action. A drunkard who is "dead drunk" is, accurately speaking, one who is killed by the paralysing effect of alcohol on the heart, but the phrase is often applied to any one who is very drunk.

Skin.—Alcohol is a **mild diaphoretic**, partly because of its vaso-dilator action, and perhaps also because of some direct influence on the sweat-glands. As just mentioned, the cutaneous vascular dilatation leads to a feeling of warmth if the patient's cutaneous vessels were previously contracted from cold. It may be that part of the **antipyretic** power of alcohol is due to increased radiation from the dilated vessels, and also to evaporation of the increased amount of sweat. If a person is in a cold atmosphere, alcohol, by increasing the radiation from the skin, leads to the loss of so much heat that he may die from cold, although at first the increased cutaneous circulation, making him feel warmer, gives him a delusive feeling of warmth.

Kidneys.—But little alcohol is passed in the urine, still less by the lungs and skin, and none in the milk. Most of it is oxidized in the body. It acts as a mild **diuretic**; probably this is a secondary result of its vascular effects.

Nervous system.—Unless the dose be very large the whole nervous system is **stimulated**, perhaps to a slight extent directly, but chiefly as a secondary result of the vascular dilatation and cardiac stimulation. The highest functions are most affected. The person who has taken the alcohol talks more fluently and brilliantly, his wits are sharpened, he has a feeling of strength. If the dose has been large, the stage of exaltation of these or any other functions quickly passes into one of depression, the highest functions being affected first, and the stimulation and depression of function proceed regularly from the highest to the lowest. The action of alcohol thus illustrates both the fact that stimulation is usually succeeded by depression, and also the "law of dissolution," which (p. 96) states that functions which have appeared latest in the animal series of the individual are the most easy to influence, those which have appeared earlier are less easy to influence; and so by regular sequence till we arrive at those functions which are first developed, which are the last to be influenced. The stimulation and subsequent depression of function therefore proceed in a descending scale from the highest or least firmly fixed function to the lowest or most firmly fixed. Thus the power of judgment is abolished very early by alcohol; this is so while the imagination, the emotions, and the power of speech, still remain stimulated; but soon the power of imagination goes, the patient loses all command over his emotions, he cries and laughs irregularly, but this soon stops. He next begins to lose control over his speech, talking incoherently and thickly; shortly afterwards he cannot talk at all, but can only make a noise. Muscular movements, which are not so highly developed as those of speech, are next affected; delicate, lately developed movements, as writing, feeding himself, &c., are for a time performed incoordinately, but soon they are paralysed. Next the muscular movements developed before these are implicated, and the patient cannot undress himself or walk straight, and incoordination of these movements passes into the inability to do them at all. Next the activity of the reflex centres of the cord is abolished, the patient passes his urine and fæces under him. Then the respiratory centre, which was previously stimulated, becomes paralysed, breathing is difficult, and the face is livid. Lastly, the heart, which was also at first stimulated, is paralysed, and the patient dies. The depression of the reflex centres of the cord accounts for the fact that injuries which would kill a sober man do not kill a drunken one, for the heart and respiration, owing to the general central depression, are not affected reflexly by them.

THERAPEUTICS.

External.—Four parts of rectified spirit to one of water form the Lotio Spiritus of many pharmacopœias. Rags or lint dipped in it are applied to sprained joints, bruises, &c. The alcohol evaporates, cools the part, consequently the vessels contract, and inflammation may thus be checked. At the same time the local anæsthetic effect of the cold relieves the pain. In a similar way many varieties of headache may be soothed by bathing the forehead with eau de Cologne. Brandy or some other form of alcohol is often used to bathe the skin in order to harden it by abstraction of water, and thus prevent the formation of bedsores or cracked nipples. Spirit lotions dabbed on the skin may, by means of the local vascular contraction produced, stop sweating. Alcohol rubbed in, as in the use of Linimentum Camphoræ Ammoniatum, is commonly employed for its rubefacient effect, to aid the absorption of inflammatory products and to relieve pain, as in chronic rheumatism, myalgia, &c.

Internal.—*Mouth.*—A little brandy held in the mouth will be a local anæsthetic and relieve toothache. Alcohol is used in the form of a gargle of port wine for its power of precipitating albumen and acting as an astringent in cases of chronic sore throat, excessive salivation, or inflammation of the gums.

Stomach.—Because it increases the secretion of gastric juice, the vascularity and the movements of the stomach, alcohol aids digestion. It must only be taken in small quantities, for large amounts paralyse the secretion and cause gastritis, and ultimately lead to atrophy of the gastric glands. It should be given just before or during a meal. It is harmful in acute dyspepsia, but for the indigestion of the aged and feeble, or for those who are thoroughly exhausted by overwork, it is very valuable, as the stomach shares in the general exhaustion. It is also useful because it increases the appetite. Owing to its anæsthetic property it may relieve painful dyspepsia, and may check vomiting, especially if taken with carbonic acid gas, as, for example, in the form of champagne or brandy and soda-water, and because it increases the activity of the gastric movements it may relieve flatulence. A single dose of strong spirits poured into the stomach is often employed with great benefit for its reflex stimulant effects on the circulation for those who have fainted, or who are collapsed from cold or any other cause.

Intestines.—Brandy and water will often check diarrhœa. Perhaps this is owing to the astringent power of the brandy.

Fever.—Alcohol has been largely used in all sorts of febrile conditions. We have seen that it impairs oxidation by its action on the red corpuscles, that it is oxidized and is therefore a food, and that it is mildly antipyretic and diaphoretic. These results would be beneficial in fever. On the other hand, the acceleration of the pulse would be distinctly harmful, although it must be remembered that very often, for some unexplained reason, alcohol lowers the pulse in fever; the indigestion caused by the taking of large quantities, and the liability to depression of the respiratory and cardiac centres, would be very undesirable. The best rules are that while alcohol may be given often with immense advantage in fever, either to aid digestion, to slow the pulse, as a cardiac stimulant if the patient be much collapsed, or to produce sleep, yet it may in any of the ways alluded to do harm. Therefore, when it is being used, the effect must be carefully watched, and if the pulse becomes quick and feeble, or, as indicating gastric irritation, the tongue becomes dry and brown, or the skin becomes hot and dry, or the breathing hurried, or the patient suffers from insomnia, the alcohol should be stopped. On the other hand, if the pulse becomes stronger and slower, the tongue and skin moist, the breathing tranquil, and the patient sleeps well, the drug is doing good, and may be continued. We have so many more powerful diaphoretics and antipyretics that alcohol is not often given for these purposes. Of all fevers it is most used for acute lobar pneumonia, and, speaking generally, it is most likely to be valuable when our object is to keep up the patient's strength for a few days only, till the termination of a specific fever of short duration ; but it is often given when it is quite unnecessary.

Nervous system.—Alcohol may, as just mentioned, be used as a soporific in fever. Many persons who suffer from insomnia find that they can sleep better for a glass of whisky and water just before going to bed, no doubt because of its depressant action upon the highest centres.

Kidneys and Skin.—Alcohol is occasionally given as a diuretic. Gin is the best form, because it usually contains some juniper, which is also diuretic. Although but little alcohol is excreted by the kidneys, it seems to be particularly irritant to the urethra in cases of gonorrhœa and gleet, and some authorities consider that chronic Bright's disease may be induced by alcohol. Almost the only use made of its diaphoretic effect is as a help to cure a cold in the head, for which purpose a strong glass of spirits and warm water may be taken immediately before going to bed.

TOXICOLOGY.

Large doses of alcohol will produce death, either instantly by reflex stoppage of the heart, or later by cardiac and respiratory depression after absorption.

Chronic poisoning causes so many diseases that it is really a part of medicine. Very often confirmed drunkards, particularly if they take much spirits, are very thin; this is probably due to the fact that strong spirits cause such marked indigestion that no nourishing food is absorbed. Other drunkards are fat, especially if they drink beer. Chronic gastritis, cirrhosis of the liver, gout, peripheral neuritis, delirium tremens, mania, and perhaps chronic Bright's disease, are all directly due to excessive indulgence in alcohol. It renders patients particularly liable to phthisis, and makes them bad subjects for withstanding any severe illness, especially pneumonia.

CHLOROFORMUM.

Chloroform or Trichloromethane. $CHCl_3$.

SOURCE.—Heat a mixture of distilled water, chlorinated lime, slaked lime, and ethylic alcohol. About 1 per cent. of absolute alcohol is added to preserve it, for pure chloroform rapidly becomes acid, and gives off irritating vapours.

CHARACTERS.—A colourless heavy liquid, Sp. gr. between 1·49 and 1·495, of a sweetish taste and a peculiar odour. It imparts a green colour to flame. *Solubility.*—1 in 200 of water, in which it sinks in heavy drops; 10 in 7 of alcohol (90 per cent.): freely in ether, olive oil, or turpentine. To be kept in a cool, dark place.

IMPURITIES.—Hydrocarbons, shown by darkening with sulphuric acid; non-volatile compounds, shown by not completely evaporating, and by unpleasant odour; acids; free chlorine.

TESTS FOR PURITY.—(*a*) It must not redden blue litmus; (*b*) nor render cloudy silver nitrate; (*c*) nor give blue colour with cadmium iodide and starch; (*d*) nor turn yellow when agitated for one hour with H_2SO_4.

Dose, 1 to 5 m. internally.

Preparations.

1. **Aqua Chloroformi.**—Chloroform, 1, well shaken with water, 400. *Strength.*—1 in 401.

This is half the strength of that in B. P. 1885.

Dose, ½ to 2 fl. oz.

2. **Linimentum Chloroformi.**—Equal parts of chloroform and camphor liniment.

3. Spiritus Chloroformi. *Synonym.*—Chloric ether. Chloroform, 1; alcohol (90 per cent.), 19. *Strength.*—1 in 20.

Dose, 5 to 20 m. for repeated administration, **30 to 40 m.** for a single administration.

4. Tinctura Chloroformi et Morphinæ Composita.—A close imitation of the proprietary medicine called chlorodyne. Mix chloroform, $1\frac{1}{2}$ fl. oz., tincture of capsicum, $\frac{1}{2}$ fl. oz., tincture of Indian hemp, 2 fl. oz., oil of peppermint, 14♏, and glycerin, 5 fl. oz., with alcohol (90 per cent.), 9 fl. oz. Dissolve morphine hydrochloride, $87\frac{1}{2}$ gr., in the mixture. Add to it diluted hydrocyanic acid, 1 fl. oz., and enough alcohol (90 per cent.) to make 20 fl. oz. *Strength.*—10 ♏ contains chloroform, $\frac{3}{4}$ ♏; morphine hydrochloride, $\frac{1}{11}$ gr.; Acidum hydrocyanicum dilutum, $\frac{1}{2}$ ♏.

Dose, 5 to 15 m.

N.B.—The composition and proportion are quite different from B. P. 1885. The morphine is more than 4 times as much in the present preparation, which is very nasty.

ACTION.

External.—Chloroform in many respects acts like alcohol, but it is more powerful. Thus **if allowed to evaporate** on the skin it produces **cold**; therefore the vessels at the point of application contract, and at the same time **local anæsthesia** is induced. If the vapour be confined, or if chloroform be rubbed into the skin, it acts as an **irritant**. The vessels dilate, the part becomes red, and there is a sense of heat. This rubefacient effect may pass on to vesication.

Internal.—*Mouth.*—If concentrated, it produces irritation and a burning sensation. If dilute, it has a **sweetish taste**, which renders Aqua Chloroformi a valuable vehicle for the administration of nauseous drugs. It reflexly gives rise to an increased secretion of saliva, and is a local anæsthetic.

Stomach.—The action of chloroform is **very like** that of **alcohol**. Large doses cause marked gastro-intestinal irritation. Small doses produce a feeling of warmth, dilatation of the gastric vessels, an increased secretion of gastric juice, and more regular and more powerful gastric movements. It is perhaps slightly astringent to the intestines.

Absorption.—It is absorbed into the blood from the stomach and intestines, and, if given as vapour, from the lungs, but it is very uncertain what changes it subsequently undergoes. Probably most of it is decomposed, but some is certainly eliminated in the breath and some in the urine, and it may be found in the blood of those who have been poisoned by it.

Temperature.—The temperature falls about 1° F. after the prolonged administration of chloroform.

Nervous system.—Chloroform is an excellent instance of the law of dissolution (*see* p. 96), and also of the well-known fact that drugs which in small doses stimulate any part in large doses often depress it. The phenomena resulting from the inhalation of chloroform are commonly divided into three stages.

First stage.—This is at first one of general stimulation, the highest functions being the most stimulated, usually unevenly, so that the patient is somewhat incoherent. The imagination is momentarily excited, and he experiences a general feeling of warmth and comfort spreading over the entire body. The mind, from the irregular excitation, is confused. Sight and hearing are stimulated, he experiences sensations of light and hears noises. The stimulation of all these higher functions is very transitory, and he quickly begins to lose consciousness; he may be aware that people around him are talking without knowing what they are saying, but soon he hears and sees nothing. Sometimes during the early part of this stage he may laugh or cry. The inability to see and hear is quickly followed by considerable blunting of general sensation. At the same time that these higher functions are being depressed the lower motor functions are excited; he will kick and fight, throwing his arms and legs about, so that much strength may be required to hold him down, and he will shout and talk incoherent nonsense very loudly. Almost coincidently the stimulation of the lower centres sets in; the pulse is increased in frequency, and there is throbbing of the heart and great vessels. The first inhalation or two may produce a choking sensation and a stoppage of breathing, which is often voluntary; but soon the respirations are increased in frequency. The blood-pressure at first rises a little, and the face may be flushed. The pupils usually dilate.

Second stage.—This is best called that of depression. Some authors call it the stage of excitement, because the excitation of the motor centres may be continued into it. It is important to remember that there is no sharp boundary line between the various stages; they pass insensibly into one another. In this stage the depression of the highest functions continues, so that the patient becomes completely unconscious, and he appears to be in a deep sleep. He sees, hears, and feels nothing; hence chloroform is called a **general anæsthetic.** The excitement of the motor functions passes into depression, and he ceases to shout and struggle. Some of the reflex centres are depressed, so that when the cornea is touched the eye does not shut. The pupil is contracted. The stimulation of the cardiac and respiratory apparatus gives way to depression, the pulse and respirations become less frequent and less strong. The vaso-motor centre is depressed, blood-pressure falls. As he cannot feel pain, and the reflex activity is so lowered that the heart will not be reflexly inhibited by the shock of an operation, this is the period at which to operate safely.

Third stage.—In this there is a total abolition of reflex excitability. Even the lowest reflex centres of the cord are depressed, so that the patient may pass his urine and fæces under him; all muscular tone is abolished, and consequently the muscles are quite flaccid. Some of them, as those of the arm, were probably in this condition towards the end of the second stage. The pupil is widely dilated, probably because of the commencing asphyxia. This is the period to which the administration is pushed to facilitate the reduction of dislocations, or to enable the abdominal viscera to be felt through the abdominal wall. If still more chloroform is given, the depression of the cardiac, respiratory, and vaso-motor centres continues, the pulse becomes feeble and irregular, and the heart finally stops in diastole. At last not only its central nervous apparatus but its muscular tissue is depressed, so that it will not respond to mechanical stimulation. The respiratory movements become slight and irregular, with very long pauses between them, and as a result the patient is more or less asphyxiated. The blood-pressure gradually falls to zero. There has been much dispute as to whether chloroform kills by the heart or the respiration. The Commission appointed by the Nizam of Hyderabad reported that it killed by depression of the respiratory centre, that respiration always failed before the heart, and that the fall of blood-pressure was not due to any effect on the heart. But their results have been disputed, and it has been shown that chloroform may kill by the heart even before breathing is affected, and that the fall of blood-pressure is mainly due to a weakening effect on the heart.

The recovery from chloroform also illustrates the law of dissolution. The lowest functions, such as muscular tone, are the first to reappear; but the patient does not usually regain his mental equilibrium for hours.

With the exception of its local actions on the skin and alimentary canal, and its last effect on the cardiac muscle, chloroform acts entirely on the central nervous system, and this action is not the result of any effects on the blood, for chloroform narcotizes infusoria. The peripheral nerves are not affected, unless it be just before death.

Vomiting is very liable to occur during the administration of chloroform, and its advent is often made known by pallor and wide dilatation of the previously contracted pupil. Immediately before death the pupil may be either dilated or contracted.

THERAPEUTICS.

External.—Chloroform is employed in the form of a liniment to produce rubefacient and irritant effects in cases of chronic rheumatism, myalgia, and chronic inflammations.

Internal.—It may be used as a local anæsthetic for toothache, the tooth being plugged with a piece of cotton wool soaked in chloroform. It disguises the taste of nauseous medicines, and therefore Aqua Chloroformi is a very common vehicle, and Spiritus Chloroformi is much used as a flavouring agent. In the stomach it acts like alcohol, and is given in the same varieties of dyspepsia as are benefited by that drug. Small doses may be used as cardiac stimulants.

Inhalation.—It is inhaled to abolish sensations of pain, whether from surgical operations, biliary, renal, and intestinal colic, or parturition. In the last case not much need be given. It is also inhaled to relax muscular spasm, as in the reduction of dislocations or herniæ, or for the relaxation of muscles for diagnostic purposes, as, for example, when we wish to feel the abdominal viscera thoroughly, or to see whether a swelling is a phantom tumour; or, lastly, it is inhaled to relax spasm in cases of tetanus, hydrophobia, or in other varieties of convulsions, as chorea. The A.C.E. mixture, which consists of absolute alcohol 1 vol., chloroform 2 vols., and pure ether 3 vols., is very commonly employed for all these purposes.

The following points should be attended to in the administration of chloroform :

1. The respiration and pulse should be carefully watched for any signs of failure.

2. The operation should never be begun till reflex action is profoundly depressed—that is to say, till the stage of muscular relaxation has commenced. Many patients have been lost from neglect of this precaution, for the stimulus of the knife has reflexly stopped the heart. It is a common and dangerous error to think that, because the operation is trivial, it may be begun early; most of the deaths from chloroform have taken place when the operation has been slight.

3. Great care must be exercised if the heart be fatty or feeble from any cause, or if the patient suffer from disease of the lungs, or if he be very old.

4. In operations about the mouth care must be taken to see that no blood gets down the trachea.

5. It is desirable to have the stomach empty, therefore no solid food should be given for some hours before the administration. The patient's head must be so directed during vomiting that no vomited matters can get into the larynx.

6. False teeth should be taken out of the mouth.

7. The chloroform must be pure.

8. It should not be too concentrated. About 5 per cent. of chloroform to 95 per cent. of air is a good mixture.

9. The head should be a little raised, and the lower jaw held up so that the tongue shall not fall back over the larynx.

10. Special care must be taken when the operation necessitates awkward positions, especially if respiration is interfered with, as in the lateral position used in obstetric and renal cases.

11. Because the temperature falls the patient should be kept warm.

If the breathing becomes very weak, or stops altogether, artificial respiration should at once be commenced, the tongue being pulled forward by forceps to allow free entry of air to the lungs. The face and abdomen should be flicked with wet towels, a capsule of amyl nitrite may be inhaled, and ether or brandy injected subcutaneously. It is doubtful whether galvanization over the cardiac area is of any use; perhaps it does harm. Artificial respiration should be maintained at least an hour or so, even if there is no sign of returning life; and if there is the slightest evidence of a cardiac beat, or a single automatic respiratory movement, artificial respiration must be persevered in for even many hours. If the face be pale, the head should be lowered, and amyl nitrite is especially likely to be useful.

ÆTHER.

Ethylic Ether, or Ethyl Oxide. $(C_2H_5)_2O$.

Synonym.—Sulphuric ether.

SOURCE.—Prepared from ethylic alcohol by interaction with sulphuric acid.

CHARACTERS.—A colourless, light, volatile liquid, with a hot taste and peculiar odour. It is very inflammable, boils below 105° F., and burns with a white flame. Sp. gr. 0·735. *Strength.*—92 per cent. by volume of ethyl oxide, and 8 per cent. of ethylic alcohol.

IMPURITIES.—Water, alcohol, and fixed impurities.

Dose, 10 to 30 m. for repeated administration; **40 to 60 m.** for a single administration.

Preparations.

1. Æther Purificatus. Ether from which most of the ethylic alcohol has been removed by washing with distilled water, and most of the water by subsequent distillation in the presence of fresh lime and calcium chloride.

CHARACTERS.—A colourless liquid. Sp. gr. not exceeding 0·722 and not below 0·720; boils at 96° F.

2. Spiritus Ætheris.—Ether, 1 part; alcohol (90 per cent.), 2 parts. Sp. gr. 0·806 to 0·811.

Dose, 20 to 40 m. for repeated, **60 to 90 m.** for single administration.

3. Spiritus Ætheris Compositus. *Synonym.*—Hoffman's anodyne. Mix sulphuric acid 36 fl. oz. with alcohol (90 per cent.), 40 fl. oz. A complex ethereal compound called oil of wine is formed. After twenty-four hours slowly distil the mixture. Add water to the upper layer of distillate after it is removed from the lower, then shake it with sodium bicarbonate to neutralize the acid. Separate the ethereal liquid, add to it ether, 5½ fl. oz., and alcohol (90 per cent.), 38 fl. oz.

Dose, 20 to 40 m. for repeated, **60 to 90 m.** for single administration.

ACTION.

External.—Ether evaporates very quickly, producing **great cold**, and consequently the part to which it has been applied becomes white from the contraction of the vessels. The cold is sufficient to cause such marked **local anæsthesia** that the pain of slight operations performed upon the part anæsthetized cannot be felt. To produce this result ether is best applied as a fine spray. If it be rubbed in, or evaporation be prevented, it, like alcohol or chloroform, is an **irritant.**

Internal.—In the mouth and stomach also it acts like **chloroform** or **alcohol.** Thus ether causes a burning taste in the mouth, an increase of the saliva, of the gastric secretion and gastric movements, and dilatation of the vessels of the stomach. Consequently it is carminative and aids digestion. Directly it reaches the stomach it **reflexly** excites the heart, increasing the force and frequency of the pulse, and causing a rise of blood-pressure; it is one of the best **cardiac stimulants** we have. In the same way it excites respiration. It is quickly absorbed, and its stimulating influence on the heart and respiration is continued. It is thus a good instance of a rapidly diffusible stimulant. It is also antispasmodic.

Nervous system.—Ether is a powerful **general anæsthetic.** The phenomena and stages of ether anæsthesia are so like those of chloroform anæsthesia that the description already given (p. 263) will suffice. The following differences, however, should be noticed:

(1) The heart is paralysed with much greater difficulty by ether than by chloroform.

(2) The same is true of the vaso-motor centre.

(3) And also of the respiratory centre.

(4) Ether is much more irritant to the respiratory mucous membrane, and hence is more liable to increase bronchitis in those already suffering from it.

(5) With ether the stage of stimulation is more protracted, therefore there is more struggling.

(6) For the same reason the anæsthetic stage is not reached so soon.

(7) The reduction of temperature is greater with ether.

(8) Ether must be given nearly pure, about 30 per cent. of air to 70 of ethereal vapour; hence it is more difficult to administer.

(9) The smell of ether is more disagreeable, and patients dislike it more.

(10) Ether is eliminated more slowly, and hence the smell hangs about the patient some time.

(11) Ether being very inflammable cannot be used in the close neighbourhood of a naked light.

THERAPEUTICS.

External.—Ether, allowed to evaporate, may be used to cause local anæsthesia in cases of neuralgia. An ether spray is occasionally employed to produce local anæsthesia for small operations; but as the ether makes the skin hard and brawny the operation must be quite superficial, and even then there is much subsequent tingling and pain.

Internal.—*Stomach.*—It may be used for the same classes of dyspepsia as chloroform or alcohol, and is often employed as a carminative to expel gas in flatulent dyspepsia.

Heart.—Administered subcutaneously (dose, 10 to 15 ♏) or by the mouth, ether is an excellent cardiac stimulant of great value in fainting, cardiac failure, or palpitation, its advantage over chloroform and alcohol being that it is more rapid in its action. It is very useful as an antispasmodic during an attack of asthma.

Inhalation.—Ether is inhaled for the same purposes, and with the same precautions, as chloroform. There is great divergence of opinion which is the safer anæsthetic. All the published statistics in which the two are contrasted appear to show that ether is much safer, and this is what might have been expected from the contrast between the two already given. Chloroform is administered carelessly more often than ether, as it is easier to give, but even allowing for this ether is probably on the whole safer. The nausea and vomiting which sometimes follow the administration of ether may, it is said, be checked by giving 15 grains of sodium bromide. Very often anæsthesia is commenced with a few inhalations of nitrous oxide gas, and then completed with ether. This is much pleasanter for the patient than to use ether from the first.

ÆTHER ACETICUS.

Acetic Ether. An ethereal liquid consisting of ethyl acetate, $CH_3COO(C_2H_5)$, together with unimportant amounts of ethylic alcohol and other substances.

Source.—A mixture of sodium acetate, sulphuric acid, and alcohol is distilled. The distillate is digested with dried potassium carbonate, and the portion boiling between 165° and 172° F. is separated.

Characters.—A colourless, fragrant liquid. Sp. gr. 0·9 to 0·905. *Solubility.*—1 in 10 of water; freely in alcohol or ether.

Dose, 20 to 40 m. for repeated administration; **60 to 90 m.** for a single administration.

It is used in Liquor Epispasticus as a solvent for cantharidine.

Action and Therapeutics.

It acts like ether, as a stimulant, antispasmodic, and carminative, but has a pleasanter taste.

CLASS III.—**Nitrites.**

Spiritus Ætheris Nitrosi, Amyl Nitrite, Nitroglycerin, Sodium Nitrite, and **Ethyl Nitrite.**

All these dilate the peripheral vessels, and increase the rapidity of the heart.

SPIRITUS ÆTHERIS NITROSI.

Spirit of Nitrous Ether. *Synonym.*—Sweet spirits of nitre.

This is a solution in alcohol of several substances, the chief being ethyl nitrite, aldehyde, acetic acid, and acetic ether.

SOURCE.—Distil a mixture of alcohol (90 per cent.), nitric acid, sulphuric acid, and copper, and dissolve the distillate in alcohol (90 per cent.).

CHARACTERS.—Transparent, nearly colourless, mobile, inflammable, slightly acid liquid of an apple-like odour and a sweet cooling taste. *Strength.*—According to the Pharmacopœia it must contain between 2·5 and 1·75 per cent. of ethyl nitrite. Sp. gr. 0·840 to 0·845.

INCOMPATIBLES. — Potassium iodide, iron sulphate, tincture of guaiacum, gallic and tannic acids, and emulsions.

IMPURITY.—Excess of acetic acid.

Dose, 20 to 40 m. for repeated, **60 to 90 m.** for single administration.

ACTION.

External.—Spirit of nitrous ether evaporates when it is applied externally, and a slightly anæsthetic effect is produced.

Internal.—It combines the action of the ether with that of the nitrites contained in it. Because of the ether it is a **diffusible stimulant**, a **stomachic**, and a **carminative.** Because of the nitrites it acts like amyl nitrite; but as the ethyl nitrite is so diluted, its action in this direction is feeble: thus it only **moderately dilates the vessels**, and except in poisonous doses probably does not affect the blood. The dilatation of the vessels leads to a **diaphoretic** effect on the skin, a **diuretic** effect on the kidneys, and a lowering of arterial blood-pressure. The dilatation of the cutaneous vessels, the sweating, and perhaps the changes in the blood, produce a slight antipyretic influence. It is obvious that in these effects the nitrites will to some extent be aided by the ether.

THERAPEUTICS.

For its diaphoretic and slight antipyretic effects it is commonly given in mild febrile attacks, such as a common cold. It is also used as a diuretic in chronic Bright's disease, and cardiac and pulmonary diseases accompanied by œdema.

AMYL NITRIS.

Amyl Nitrite.

SOURCE.—Produced by the interaction of nitrous acid and amylic alcohol that has been distilled between 262° and 270° F. It consists chiefly of isoamyl nitrite, $C_5H_{11}NO_2$, but also contains other nitrites of the homologous series.

CHARACTERS.—An ethereal liquid of a pale yellow colour, and smelling strongly like the sweetmeat known as pear drops, which are flavoured with it. Sp. gr. 0·88. Very volatile. Soluble in ether, chloroform, or spirit, but not in water.

IMPURITIES.—Free acid and amyl nitrate.

Dose, 2 to 5 m., cautiously inhaled from a handkerchief in which a glass capsule containing the nitrite of amyl has been crushed.

ACTION.

External.—Locally applied it diminishes the activity of the sensory nerves, but they quickly recover.

Internal.—Amyl nitrite is rarely given by the mouth, so the following account will refer to the effects of inhalation.

Circulation.—From a medical point of view by far the most important effects of amyl nitrite are those produced upon the heart and vessels. Within a minute of inhalation the face **flushes**, the **heart** beats very **rapidly** and **violently**, there is a throbbing in the head, and the vessels, *e.g.* the carotids, may be seen to pulsate actively. Headache, giddiness, dilatation of the pupils, and increased respiratory movements quickly supervene. All the vessels of the body rapidly dilate, hence the flushing. They may be actually seen to widen in the ear of a rabbit or in the retina. This is due to a direct action on the muscular coats of the arterioles, for it happens if the cord is destroyed. The blood-pressure and arterial tension of course fall very low. The increase in the rate of the pulse is unaccompanied by any alteration in the force of the beat; it is apparently due to a depressing influence on the inhibitory vagus centre. In toxic doses the heart may be arrested in diastole from direct action on the cardiac muscle.

Respiration.—The rapidity and depth of respiration are at first increased, probably from central stimulation; the respiratory centres are later depressed, the breathing becoming slower and shallower, and usually death finally occurs from paralytic asphyxia of central origin.

Nervous system.—Many of the symptoms referable to the nervous system are secondary effects of the dilatation of the vessels of the brain and spinal cord. Such are the throbbing, sense of fulness, giddiness, and headache noticed directly after inhalation. The headache may remain some time. If much has been inhaled there is unsteadiness of gait and general restlessness. The pupil dilates, and disturbances of vision are present. The motor centres of the cord are profoundly depressed, therefore after large doses reflex actions are abolished. The function of sensory nerves, motor nerves, and muscles is depressed by the local application of the drug to them, but not after inhalation until shortly before death.

Temperature.—Amyl nitrite causes this to fall considerably both in fever and health. The fall is due to the peripheral vascular dilatation, and, if large doses are given, to the changes in the blood.

Urine.—The drug probably escapes in the urine; it is slightly diuretic, and may cause glycosuria, due, it is said, to dilatation of the vessels of the medulla.

Blood.—Outside the body nitrites greatly diminish oxidation, and the same takes place in the blood. After the inhalation of a considerable amount (more than is usually given to a man) the arterial and venous blood both become a uniform chocolate colour. This is due to the formation of methæmoglobin and another body, probably nitric oxide hæmoglobin. The blood can no longer absorb oxygen, and hence its oxidizing power is abolished. It is by this action on the blood that in man nitrites kill, not by their vaso-dilator action; therefore the treatment for poisoning by them is inhalation of oxygen. In some of the lower animals they kill by acting as a direct poison to animal tissues.

THERAPEUTICS.

Heart and Blood-vessels.—Dr. Brunton in 1867 observed that in a case of angina pectoris the peripheral vessels were strongly contracted during an attack of pain. This induced him to make the patient inhale amyl nitrite, and it was found that the vessels dilated and the pain passed off. Inhalation of amyl nitrite is now used for all sorts of cardiac pain, especially when it comes on in paroxysms. Generally the drug affords relief in a minute or so after inhalation, but by no means always. We do not sufficiently understand the pathology of angina pectoris to know how it acts. It may be by dilating the peripheral vessels, but against that view is the fact that they are not always contracted during attacks of angina pectoris, amyl nitrite may relieve patients in whom the vessels are not contracted. The attacks of pain common in thoracic aneurysm may be relieved by it. It is used to avert the pallor sometimes seen during the administration of chloroform. The peculiar hot flushes experienced by some women during the menopause are benefited by inhalation of it.

Nervous system.—If it is inhaled when the aura is felt, an epileptic fit may sometimes be prevented, and it has also been found useful during the status epilepticus. Because in migraine the vessels of the head are contracted, it has been used, and sometimes successfully, for this complaint. Its depressing action on the cord has suggested its employment in tetanus and strychnine poisoning.

Occasionally the inhalation of amyl nitrite relieves an attack of asthma. It has been given in whooping-cough, sea-sickness, and cholera, but without much good effect.

NITRO-GLYCERIN.

Trinitroglycerin. $C_3H_5[(NO_2)O]_3$. (Not official.)

Synonyms.—Trinitrin, Glonoin oil, Nobel's blasting oil.

SOURCE.—Glycerin is dropped into a mixture of sulphuric and nitric acids kept cool by ice.

CHARACTERS.—A colourless oily liquid. Sp. gr. 1·6, slightly soluble in water, easily in fats, oil, alcohol, ether. Highly explosive. Mixed with silica forms dynamite.

Dose, $\frac{1}{200}$ to $\frac{1}{50}$ gr., never used undiluted.

Preparations.

1. **Liquor Trinitrini.**—Nitro-glycerin, $17\frac{1}{2}$ gr., alcohol (90 per cent.), 4 fl. oz. *Strength.*—1 per cent. Sp. gr. 0·840.

Dose, $\frac{1}{2}$ to 2 m.

2. **Tabellæ Trinitrini.**—Nitro-glycerin, $\frac{1}{100}$ gr.; chocolate, 5 gr. Chocolate is used, as with it there is very little risk of explosion.

Dose, 1 or 2 tablets.

ACTION AND THERAPEUTICS.

Its action is the same as that of amyl nitrite, except that in many animals and probably in man large doses do not form methæmoglobin in the blood, the effects of nitro-glycerin are **more persistent**, and as it is only suitable for internal administration they are slower in their onset. It is largely taken by persons liable to cardiac pain, with the object of warding off the attack. Small doses are often used to lower the arterial tension in chronic interstitial nephritis. It is really a nitrate of glycerin, but certainly physiologically it belongs to the class of nitrites, therefore it is supposed that directly it gets into the body a nitrite is formed.

SODII NITRIS.

Sodium Nitrite. $NaNO_2$.

SOURCE.—Made by heating sodium nitrate with lead, which becomes an oxide, taking oxygen from the nitrate.

CHARACTERS.—A white crystalline deliquescent powder, very soluble in water.

Dose, 1 to 2 gr.

LIQUOR ETHYL NITRITIS.

Solution of Ethyl Nitrite.

A mixture of 95 parts by volume of absolute alcohol, with 5 parts by volume of glycerin, containing, when freshly made, 3 per cent. by weight, and even when long kept not less than 2½ per cent. of ethyl nitrite.

SOURCE.—Obtained by the interaction of alcohol (90 per cent.), sodium nitrite, and diluted sulphuric acid at a low temperature.

CHARACTERS AND TESTS.—A limpid, almost colourless liquid with characteristic apple-like odour and taste. Highly inflammable. Sp. gr. 0·823 to 0·826. Should be stored in small bottles.

Dose, 20 to 60 m.

ACTION AND THERAPEUTICS.

The action of sodium nitrite and ethyl nitrite is the **same as** that of **amyl nitrite** and other nitrites. They are suitable for the same cases as nitro-glycerin, as they are **slower and gentler** in their action than amyl nitrite. Sodium nitrite has the same action on the blood as amyl nitrite.

CLASS IV.—**Hypnotics.**

Chloral Hydras, Butyl-chloral Hydras, Chloral-amide, Paraldehydum, Sulphonal, Trional, Tetronal.

CHLORAL HYDRAS.

Chloral Hydrate, or Trichlorethylidene glycol.
$CCl_3 \cdot CH(OH)_2$.

SOURCE.—Anhydrous ethylic alcohol is saturated with dry chlorine, and thus chloral is formed. It is purified by sulphuric acid, then by lime; water is added to form a hydrate.

CHARACTERS.—Colourless monoclinic crystals of a pungent, peculiar odour and a bitter taste. Easily melted by gentle heat. *Solubility.*—Freely in distilled water, alcohol (90 per cent.), and ether. Forms a fluid when rubbed up with an equal weight of camphor.

INCOMPATIBLES.—All alkalies decompose it.

IMPURITIES.—Hydrochloric acid and oily impurities.

Dose, 5 to 20 gr.

Preparation.

Syrupus Chloral. *Strength.*—10 gr. in 1 fl. dr. **Dose, $\frac{1}{2}$ to 2 fl. dr.**

ACTION.

External.—It is a powerful **antiseptic.** Locally applied it is irritant, causing vesication.

Internal.—*Alimentary canal.*—Unless diluted chloral hydrate is a gastric irritant; large doses therefore may give rise to vomiting and purging.

Blood.—It is readily absorbed, and circulates in the blood unchanged. It was formerly thought that as alkalies convert it into chloroform and formic acid, this change would take place in the blood, and consequently Liebreich suggested its use as an hypnotic. It is now known that this view is wrong, for no chloroform can be found in the blood of chloralized animals, nor in the breath, nor in the urine unless that fluid is alkaline, in which case chloral hydrate is decomposed by the alkali in the urine.

Circulation.—Chloral hydrate **depresses the heart**, large doses having this action to a considerable degree. This is due to a local effect on the organ itself; probably both the muscular substance and the nerves contained in it are affected. The pulse, which may at first be slightly quickened, soon becomes slow, feeble, and irregular, and the heart finally stops in diastole. The **vaso-motor centre is depressed**, and consequently the vessels dilate. As a result of these actions on the heart and the vessels the **blood-pressure falls.**

Respiration.—After large doses the respirations become slow and full, and after toxic doses they become irregular and shallow before finally ceasing. This is due to the action of chloral hydrate on the respiratory centre.

Temperature.—Large doses cause this to fall by diminishing the production of heat.

Brain.—Chloral hydrate is a **powerful hypnotic,** acting directly on the brain. The stage of excitation, if it exists, is very short. Soon after taking a moderate dose the patient is overcome by sleep, which lasts several hours, and is indistinguishable from natural sleep. On waking there is neither confusion nor headache, and he feels refreshed. Large doses produce coma. The pupil is always contracted.

Spinal cord.—At first the anterior cornua may be slightly stimulated, but soon they are depressed, and there is consequently paralysis and loss of reflex excitability. The motor nerves and the muscles are not affected, nor are the sensory nerves unless the dose is very large, when there may be anæsthesia.

It will be observed that chloral hydrate is a **powerful general depressant**, chiefly of the cerebrum, but also of the respiratory centre, the vaso-motor centre, the anterior cornua, the production of heat, and the heart. It is only because it depresses the cerebrum much earlier than any other part of the body that we can use it as an hypnotic. Chloral hydrate is often called chloral, but this is an oily liquid.

THERAPEUTICS.

External.—The compound with camphor has been employed as a local anodyne for neuralgia, and may be applied to aching teeth.

Internal.—Chloral hydrate is largely used for its hypnotic effect. Its great advantages over many other hypnotics are that doses sufficient to produce a deep sleep are not large enough to cause gastro-intestinal irritation, cardiac and respiratory depression, and the other harmful effects. Chloral hydrate is certain in its action ; it quickly produces sleep ; and there are no bad after-effects. Children take it well.

It is especially useful in simple insomnia from overwork, worry, &c. Its disadvantages are that it does not relieve pain at all, and it should therefore not be used for insomnia due to this cause ; and that, as it depresses the heart and respiration, it must be given carefully in diseases of the heart and lungs, and also when the stomach or intestines are diseased, as it may irritate these structures. In febrile insomnia it is very valuable in the early stages, but must be given cautiously later when there is any danger of cardiac weakness. It does not relieve the distress and cough of diseases of the heart and lungs. It has been used as a cerebral depressant in delirium tremens, puerperal convulsions, and mania, but very large doses are required, and consequently the results must be watched with great care.

From its action on the spinal cord chloral hydrate has been used, and sometimes with success, in tetanus, whooping-cough, incontinence of urine, and strychnine poisoning.

TOXICOLOGY.

Acute Poisoning.—As will be inferred from the action of chloral hydrate, the symptoms of poisoning by it are deep coma; a weak, feeble, irregular, slow pulse, which may become quick before death; diminished frequency of respiration and consequent lividity; and abolition of reflex movements. The surface of the skin is cold, and the temperature is subnormal.

Treatment.—Give emetics (see p. 129) or wash out the stomach. Keep up the temperature by hot bottles, hot blankets, friction, and massage. Prevent sleep by the injection of hot strong coffee into the rectum, shouting at the patient, hitting him, flapping with wet towels, bathing, &c. Give a subcutaneous injection of strychnine, because of its stimulant action on the anterior cornua. Use inhalations of amyl nitrite to stimulate the heart, and artificial respiration if necessary.

Chronic poisoning.—The taking of chloral hydrate is a vice to which many persons are addicted. A craving for it is soon established. The chief symptoms of chronic chloral poisoning are gastro-intestinal irritation, a great liability to erythematous eruptions, dyspnœa dependent upon the cardiac and respiratory depression, and general weakness. There may be disturbance of the mental equilibrium, and persons have been known to become permanently weak-minded. A slightly larger dose than usual may be quickly fatal.

BUTYL-CHLORAL HYDRAS.

Butyl-chloral Hydrate, Trichlorbutylidene Glycol.

$CH_3 \cdot CHCl \cdot CCl_2 \cdot CH(OH)_2$.

Synonym.—Croton chloral hydrate. (This is a misnomer.)

SOURCE.—Dry chlorine gas is passed through aldehyde. Butyl-chloral is formed. It is separated by fractional distillation, and water is added.

CHARACTERS.—Pearly white crystalline scales, with a nauseous taste and a pungent odour like chloral hydrate. *Solubility.*—1 in 50 of water; freely in spirit and glycerin.

INCOMPATIBLES.—All alkalies.

Dose, 5 to 20 gr.

ACTION AND THERAPEUTICS.

The action of this drug is exactly similar to that of chloral hydrate, but butyl-chloral hydrate is less certain in its effects. It is said to be less depressant to the heart, but this is doubtful. It has a specific action in relieving neuralgia of the fifth nerve.

Chloralamide.—(Not official.

Synonym.—Chloral formamide.

CHARACTERS.—Shining colourless crystals. Taste slightly bitter. *Solubility.*—Slowly in about 1 in 20 of water, 1 in 4 of alcohol (90 per cent.), and in weak acid solutions. Should not be heated over 140° F., or mixed with alkalies, for in either case it decomposes.

Dose, 10 to 40 gr.

ACTION AND THERAPEUTICS.

Chloralamide is an excellent hypnotic, producing calm refreshing sleep without any bad after-effects. It has little or no depressant action. Frequent use does not necessitate an increased dose, nor, as far as we know, is any chloralamide habit contracted. It does not relieve pain, but is equally serviceable for all varieties of insomnia unless due to pain. If possible it should not be given as a powder, for it is then so very slowly absorbed that probably some of it is decomposed in the intestines or stomach; occasionally, when powdered chloralamide has been administered in the evening, the patient has not slept during the night, but has slept all the next day, because the drug has been so slowly absorbed. The best way to give it is to dissolve it in a little alcohol. The patient may be told to dissolve 20 or more grains in sufficient brandy, to add water not above 130° F., and drink it before going to bed. It will require stirring for some time. Some specimens are very insoluble, and must be suspended. It is said that 10 minims of aromatic sulphuric acid added to 1 fl. oz. of water will dissolve 30 gr. of chloralamide, but this is not always true. It acts if given as an enema. Fifteen grains of each of potassium bromide and chloralamide, flavoured with tincture of orange and chloroform water, has been strongly recommended for insomnia and for sea-sickness. This mixture resembles a proprietary preparation called chlorobrom.

PARALDEHYDUM.

Paraldehyde. $C_6H_{12}O_3$.

SOURCE.—A product of the polymerization of aldehyde by means of various acids or salts. For example, aldehyde may be acted on by hydrochloric acid, sulphuric acid, or zinc chloride; during the action the mixture becomes hot; on cooling to 32° F. paraldehyde crystallizes. $3C_2H_4O = C_6H_{12}O_3$.

CHARACTERS.—A colourless liquid of ethereal odour and burning taste. It freezes at 50° F., boils at 250° F. Sp. gr. 0·998. *Solubility.*—1 in 10 of water; freely in alcohol and ether. It should be kept preserved from light and air.

Dose, $\frac{1}{2}$ to 2 fl. dr.

ACTION.

External.—It is antiseptic.

Internal.—Even large doses do not affect the gastro-intestinal tract, heart, or respiration; but enormous doses weaken the heart, and kill by paralysis of the respiratory centre.

Nervous system.—It is a **powerful hypnotic,** without any unpleasant after-effects. It acts quickly, and the sleep, which lasts several hours, is quiet, refreshing, and dreamless. Paraldehyde in toxic doses paralyses the anterior cornua of the spinal cord; thus it abolishes reflex action and causes paralysis. It does not affect nerves or muscles.

THERAPEUTICS.

It is given solely as an hypnotic in the same class of cases as chloral, and as it does not act on the heart it may also be used for patients suffering from cardiac disease. It has been used largely in asylums to produce quiet in mania and sleep in melancholia.

It may produce an erythematous rash. The great objection to its use is its nasty taste, which is best covered by syrup and tincture of orange peel with at least two fluid ounces of water to ensure a usual dose being dissolved. It gives an unpleasant odour to the breath, which lasts many hours.

SULPHONAL.

Dimethyl-methane-diethylsulphone.
$(CH_3)_2,C(SO_2C_2H_5)_2$.

Source.—It is a product of the oxidation of mercaptol, $(CH_3)_2C(SC_2H_5)_2$, obtained from acetone and mercaptan.

Characters.—Colourless prismatic crystals, inodorous, almost tasteless. *Solubility.*—1 in 450 of cold, 1 in 15 of boiling water; 1 in 90 of alcohol (90 per cent.) or ether; 1 in 3 of chloroform.

Dose, 10 to 30 gr., in cachets or suspended in mucilage, or in flavoured boiling water, drunk as soon as cool enough.

Action and Therapeutics.

Sulphonal is an **hypnotic.** It does not depress the heart, but kills by paralysis of respiration. The drug is given for the same class of cases as chloral hydrate, but as it is so insoluble it is absorbed with difficulty and very slowly; hence it takes some hours to act, and its action may be prolonged into the next day. It produces its effect most rapidly if the fluid in which it is suspended is hot. It has been known to produce eruptions on the skin and hæmatoporphyrin in the urine.

Tetronal and Trional.—(Not official.)

These two substances have the same general formula as sulphonal (q.v.), except that sulphonal contains two ethyl groups, and these bodies contain four and three respectively.

Dose, Tetronal, **10 to 20 gr.**; Trional, **10 to 30 gr.** Both are best given in cachets.

They are used for the same purposes as sulphonal, and like it may produce hæmatoporphyrinuria.

CLASS V.—**Drugs which have an Antipyretic or Analgesic Action.**

Acetanilidum, Phenazonum, Phenacetinum, Exalgin, Resorcin.

ACETANILIDUM.

Acetanilide. $CH_3 \cdot CO \cdot NH \cdot C_6H_5$.
Synonyms.—Antifebrin, Phenyl-acetamide.

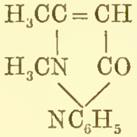
SOURCE.—Glacial acetic acid and aniline are heated together. $C_6H_5NH_2 + HC_2H_3O_2 = CH_3 \cdot CO \cdot NH \cdot C_6H_5$. Acetanilide is distilled over and purified by crystallization.

CHARACTERS.—Colourless scaly crystals of a pungent taste. *Solubility.*—1 in 200 of cold water, 1 in 18 of boiling; 1 in 4 of alcohol (90 per cent.); freely in ether and chloroform.

Dose, 1 to 3 gr., in tablets, cachets, or suspended.

PHENAZONUM.

Phenazone. $C_{11}H_{12}N_2O$. *Synonyms.*—Antipyrine, Phenyl-dimethyl-isopyrazolone.



SOURCE.—Aceto-acetic ether is acted on by phenyl-hydrazine, when phenyl-methyl-isopyrazolone, ethyl alcohol, and water are formed. $CH_3COCH_2COOC_2H_5 + H_2NNHC_6H_5 = C_6H_5(CH_3)C_3H_2N_2O + C_2H_5OH + H_2O$. The monomethyl compound is heated with methyl iodide and methyl alcohol. $C_6H_5CH_3C_3H_2N_2O + CH_3I = C_6H_5(CH_3)_2C_3HN_2O + HI$.

CHARACTERS.—Colourless, odourless, scaly bitter crystals, freely soluble in water, alcohol, and chloroform.

INCOMPATIBLES.—Sulphate, iodide, chloride of iron; copper sulphate; iodine; iodide of arsenic; carbolic, hydrocyanic, and nitric acids; potassium permanganate; salicylates; perchloride of mercury; spirits of nitrous ether; all preparations containing tannin give a white precipitate; chloral hydrate decomposes it.

Dose, 5 to 20 gr.

PHENACETINUM.

Phenacetin. $C_{10}H_{13}NO_2$. *Synonym.*—Para-acetphenetidin. $C_2H_5{\cdot}O{\cdot}C_6H_4{\cdot}NHCOCH_3$.

SOURCE.—Glacial acetic acid is made to act upon paraphenetidin, a product of para-nitro-phenol. $C_6H_5OC_2H_5NH_2 + HC_2H_3O_2 = C_2H_5{\cdot}O{\cdot}C_6H_4{\cdot}NHCOCH_3 + H_2O$.

CHARACTERS.—Colourless, tasteless, scaly crystals, very sparingly (1 in 1700) soluble in water. Soluble in 20 parts of alcohol (90 per cent.); soluble in glycerin.

Dose, 5 to 10 gr. in cachets, capsules, or suspended.

ACTIONS OF ACETANILIDE, PHENAZONE, AND PHENACETIN.

None of these substances has any action externally or on the gastro-intestinal tract. Acetanilide and phenazone are local hæmostatics, as they contract blood-vessels when applied to them.

Blood.—With ordinary doses of these drugs this fluid is unaffected, but in large doses the colour is changed from the formation of methæmoglobin, The passage of this in the urine discolours it. Acetanilide causes the red corpuscles to break up, and arrests the movements of the white. We do not know for certain whether the other two substances can produce this result.

Heart.—All these substances **depress the heart.** It is not known how they do this, but what little evidence there is appears to show that they have a directly paralysing action on the cardiac muscle. This cardiac depression is much less marked with phenacetin than the other two, and is perhaps less with acetanilide than phenazone.

Vessels.—Acetanilide and phenazone contract the smaller vessels from direct action on their muscular coat. The blood-pressure therefore rises at first, but later it falls from the cardiac depression.

Respiration.—This is not affected by ordinary doses. After toxic doses the force of the respiratory act progressively diminishes.

Kidneys.—These substances are all mild diuretics. The excretion of urea and uric acid is stated to be increased by them. Large doses of any of them cause the urine to be dark from the passage of altered blood. Phenazone is quickly excreted as such in the urine. Acetanilide is said to be excreted as aniline, but this requires confirmation.

Skin.—Any of these three drugs may produce an erythematous rash which is usually measly or urticarial, and they are occasionally mild diaphoretics.

Temperature.—These three substances are all powerful **antipyretics.** They have a very slight action on the temperature of health, but they reduce it very markedly when it is raised from any cause. They were all introduced into medicine for this property. We have already seen (*see* p. 62) how numerous are the ways in which antipyretics may act. The fall of temperature produced by these drugs is not due to any action on the blood or the circulation, and it is too marked to be entirely owing to their slight diaphoretic action. They all decrease heat production, and it is most likely that they act directly upon that part of the central nervous system, probably the corpora striata, which presides over heat production. They all to a much less extent increase heat dissipation. The result of these two actions is that the temperature falls. The proof of these statements is too long and complicated to give here, but we may mention that it is stated to have been shown both by a calorimeter, and by the decrease of the products of the febrile destruction of tissue, such as urea, that these drugs diminish heat production.

Nervous system.—These three drugs are powerful **analgesics.** Acetanilide and phenazone in large doses are said to produce first convulsions, then coma and paralysis of motor nerves and muscles; but all these statements require further experiments.

THERAPEUTICS OF ACETANILIDE, PHENAZONE, AND PHENACETIN.

External.—Acetanilide is occasionally employed as a dusting powder, or as an ointment (20 gr. to 1 oz.), for chronic ulcers and eczema.

Internal.—*Pyrexia.*—Originally these drugs were introduced into medicine on account of the property they have of reducing pyrexia. The opinion is, however, gaining ground, that if the temperature is not dangerously high no attempt should be made to reduce it, for probably the raised temperature is an endeavour on the part of the body to defend itself against the micro-organisms which are the cause of the particular fever from which the patient is suffering; in other words, the pyrexia is a "defensive mechanism." Further, these drugs are all cardiac depressants and therefore unsuitable for patients suffering from fever, and this last consideration makes many physicians prefer to use cold water rather than these drugs when the temperature is so high that it is considered that it, in itself, is dangerous to life. Should it, however, for any reason be decided to give one of these drugs as an antipyretic, phenacetin has the great advantage of depressing the heart very little, and rarely producing the alarming toxic effects described on the next page. It is, however, very insoluble, and slower and less powerful in its action than the other two, but the effect lasts longer. In order to gain a rapid effect, those who use these drugs commonly give either phenazone or acetanilide. Phenazone has the advantage of being soluble, and the balance of evidence is that toxic symptoms are slightly more common after acetanilide, which too does not keep the temperature down quite so long as phenazone. Both take about two hours to reduce the pyrexia to its minimum, the last named being rather the more rapid of the two. Phenazone may be given subcutaneously, but this is not advisable, as sores may be produced. Either may be given *per rectum.*

Analgesic action.—All these drugs have the property of relieving pain. It is least marked with acetanilide, most with phenazone; but as phenacetin possesses it very strongly it is perhaps on the whole to be preferred as an analgesic, for toxic results after it are very rare. These drugs, especially phenazone, are largely used to relieve the pains of neuralgia, sciatica, dysmenorrhœa, locomotor ataxy, migraine, and various headaches. The dose of phenacetin for this purpose is 5 grains every hour for three or four hours; this generally gives relief. Doses of 10 grains of phenazone may be used for the same purpose. This drug has occasionally done good in epilepsy.

TOXICOLOGY.

All these drugs occasionally produce in man collapse, cyanosis, very slow respiration, a feeble and irregular pulse, vomiting, profuse sweating, and profound prostration. It is not known whether these symptoms are due to impurities in the drugs. Many deaths have been caused by them. It has been stated that during one epidemic of influenza in Vienna seventeen persons were killed by phenazone. Acetanilide is most likely, and phenacetin least likely, to be accompanied by symptoms of poisoning.

Treatment.—Stimulation by alcohol and ether subcutaneously and by the mouth. Strychnine subcutaneously to stimulate the heart. Oxygen inhalations. Warmth to the feet and body.

Exalgin.—(Not official.)

Synonym.—Orthomethyl-acetanilide. $C_9H_{11}NO$.

CHARACTERS.—Colourless acicular or tabular crystals, with a slight saline taste. *Solubility.*—1 in 60 of water; freely in alcohol.

Dose, 2 to 6 gr.

ACTION AND THERAPEUTICS.

Exalgin is a powerful analgesic, and has been given with success for neuralgia. Often it relieves when many other drugs have failed. Medicinal doses hardly ever cause any depression, but very large quantities may be dangerous, breaking up the blood like acetanilide. It is best dissolved in Tinctura Aurantii, and flavoured with Syrupus Aurantii Floris.

Resorcin.—(Not official.)

A derivative of benzene or phenol.

CHARACTERS.—White crystals resembling, but larger than, those of benzoic acid. *Solubility.*—1 in 1 of water; 1 in 20 of olive oil; easily in alcohol.

Dose, 5 to 30 gr.

ACTION AND THERAPEUTICS.

This substance, originally introduced as an antipyretic, is now rarely employed for this purpose, as it is too depressant to the heart. A solution of resorcin in glycerin, 1 in 4, is excellent for removing epidermic scales in chronic skin diseases, and also for getting rid of the scurf in seborrhœa sicca of the scalp. It is a powerful antiseptic, and a 5 per cent. solution may be injected into the bladder in cystitis.

CLASS VI.—**Antiseptics.**

Carbolic Acid, Sulphocarbolates, Creosote, Guaiacol, Iodoform, Naphthol, Creolin, Izal, Lysol, and Formaldehyd.

ACIDUM CARBOLICUM.

Carbolic Acid. Phenol, or Phenyl alcohol. C_6H_5OH.

SOURCE.—From coal tar oil by fractional distillation, and purification.

Characters.—Colourless acicular crystals of a peculiar tarry odour. Treated with about 6 per cent. of water, they become fluid; they are very hygroscopic, and hence soon become semi-fluid on exposure to air. Often reddish from the impurities aurin and rosolic acid, which form a red compound by the absorption of carbonic acid and oxygen. Melts at 91·5° F. to an oily liquid. Does not redden litmus paper, coagulates albumen. *Solubility.*—1 in 16 of water; freely in alcohol, fats, and oils.

It is contained in Liquor Thyroidei, and in Injectio Ergotæ Hypodermica.

Dose, 1 to 3 gr.

Preparations.

1. **Acidum Carbolicum Liquefactum.**—Phenol, 1; water, 10.

Dose, 1 to 3 m.

2. **Glycerinum Acidi Carbolici.**—Phenol, 1; glycerin, 5.

3. **Suppositoria Acidi Carbolici.**—1 gr. in each. Made with white beeswax and oil of theobroma.

4. **Trochiscus Acidi Carbolici.**—1 gr. in each with a tolu basis.

5. **Unguentum Acidi Carbolici.**—Phenol, 1; glycerin, 3; white paraffin ointment, 21.

Action.

External.—Carbolic acid is a powerful **antizymotic**, rapidly destroying organized ferments, both animal and vegetable. Consequently it destroys those of septic diseases, hence it is **antiseptic**. It thus prevents the formation of the products of the decompositions which are set up by these organisms. For this reason it is **disinfectant**, and as these products of decomposition are generally foul-smelling, it is **deodorant**. It does not act so readily on unorganized ferments (enzymes), such as pepsin and ptyalin, but in large doses it likewise destroys their activity. Carbolic acid is not so powerful an antizymotic as perchloride of mercury (*see* p. 194); for Evans ('Guy's Hospital Reports,' vol. xlvii.) found that anthrax spores were not killed in twenty-four hours by a solution of 1 in 100, but were killed by a solution of 1 in 20 acting for twenty-four hours, but not when it acted for only four hours. The bacilli of anthrax were killed by solution of 1 in 100 acting for five minutes, 1 in 150 acting for a quarter of an hour, 1 in 175 acting for half an hour, but were unaffected by a solution of 1 in 150 acting for one minute, 1 in 175 acting for a quarter of an hour, 1 in 300 acting for an hour. Strengths of 1 in 40 and 1 in 20 are commonly employed in surgery. The solution in oil has no antiseptic properties. The power of carbolic acid to destroy low organisms makes it an efficient **parasiticide** against certain vegetable parasites infesting the skin.

When applied to the skin in weak or moderately strong solutions, it produces **local anæsthesia** with a feeling of numbness, which lasts some hours. If concentrated it acts as an **irritant** and **caustic**, causing a burning pain, and in a few minutes a white spot appears, which becomes red when the acid is removed. If the application is prolonged a white eschar or slough results. There is no vesication.

Internal.—*Gastro-intestinal tract.*—If concentrated, carbolic acid produces the same effect on the mouth as on the skin, and is a powerful gastro-intestinal irritant (*see* Toxicology). In the stomach it is converted into a sulphocarbolate, and unless poisonous doses be given, it is so diluted by the gastric contents that it loses its antizymotic power.

Blood.—It is not known in what form carbolic acid circulates, probably as an alkaline carbolate.

Circulation.—Medicinal doses have no effect. Large doses paralyse the vaso-motor centre in the medulla, and the blood-pressure falls. It is not until very large doses have been given that the heart is affected, and then its activity is depressed.

Respiration.—Small doses have no influence on respiration, but large ones accelerate it, probably from stimulation of the vagi. Ultimately respiration is paralysed, and death results.

Temperature.—This is unaffected by small doses of carbolic acid, but large doses cause it to fall, because they diminish the production of heat and increase its dissipation.

Nervous system.—Carbolic acid is a cerebral depressant in large doses, for coma is produced by them; they first stimulate the anterior cornua, producing convulsions, but subsequently depress them, causing paralysis.

Urine.—Much interest attaches to this, for even after moderate doses of carbolic acid, or absorption from surgical dressings, **the urine may become dark**, This is not due to blood, as was once thought, for Dr. Stevenson has shown that there is no increase of iron in the urine. After taking carbolic acid, salts of sulphocarbolic acid and glycuronic acid, pyrocatechin and hydroquinone appear in the urine. The last two are oxidation products of carbolic acid. Pyrocatechin is a dark-coloured body, and is, no doubt, often the cause of the dark urine; but this cannot be the sole cause, for pyrocatechin can only exist in alkaline urines. The presence in the urine of these results of carbolic acid is recognized by distilling them over from it. The distillate gives a blue colour with neutral ferric chloride, and a white crystalline precipitate of tribromo-phenol with bromine water, showing the presence of sulphocarbolic acid. Some carbolic acid escapes in the other excretions; some is burnt up in the body, When very large doses are given, carbolic acid itself may appear in the urine.

THERAPEUTICS.

External.—Carbolic acid is largely used as a deodorant and disinfectant for drains, bed-pans (for which the cheap crude acid may be employed), soiled linen, surgical instruments, the surgeon's hands, &c. Carbolic lotion (1 in 40) is used to wash wounds to keep them antiseptic, and carbolized gauze (which is unbleached cotton gauze medicated with half its weight of a mixture of carbolic acid 1, resin 4, paraffin 4) is employed as a dressing for the same purpose. A spray of a solution of carbolic acid was formerly much used to keep the air round the wound antiseptic during an operation, but it is now discarded as unnecessary.

Glycerin of carbolic acid is a very efficient preparation to destroy the fungus of tinea tonsurans or tinea versicolor; for the latter it should be diluted.

Because of its anæsthetic effect a strong solution (1 in 20) will relieve itching from any cause. Carbolized vapour has been inhaled in phthisis, but by the time it reaches the lungs it is far too dilute to have any action on the tubercle bacilli.

Internal.—*Mouth.*—The glycerinum, if diluted, may be applied as a stimulant to the mouth in aphthous stomatitis, or when any indolent ulceration is present. A gargle (15 ♏ of Glycerinum Acidi Carbolici to 1 fl. oz. of water) is an excellent preparation. The glycerinum has been used for diphtheria, but probably it does no good, except that being a local anæsthetic it soothes pain. A piece of cotton wool soaked in strong carbolic acid will relieve pain if placed in a decayed tooth, but care must be taken to prevent it from coming in contact with the soft parts by putting another piece of dry cotton wool over it.

Stomach.—Carbolic acid has been given to relieve flatulence, because it was thought that it would prevent decomposition in the stomach; but it is powerless to do this, owing to the degree to which the gastric contents dilute it. Some state that it checks vomiting and helps to cure dyspepsia, but it is not a remedy which is universally regarded as useful for these purposes. It may, however, be tried in obstinate cases, and it will sometimes be found to be a good carminative. It has been given internally as an antiseptic in phthisis, but it does no good, and those who give it forget that probably very little carbolic acid reaches the lungs. It has also been extensively tried in typhoid fever, but without any good effect.

TOXICOLOGY.

If carbolic acid is at all concentrated, immediately on swallowing it there is an intense burning sensation in the mouth, gullet, and stomach, and white eschars form in the mouth. The patient is collapsed, his skin is cold and clammy. The breathing becomes more and more feeble and shallow, and finally stops. The urine is darkish green. Reflex movements are abolished, and ultimately he becomes insensible and comatose. *Post mortem.*—There are white, hard sloughs, with perhaps inflammatory redness round them, in the mouth, œsophagus, and stomach. The blood is dark and coagulates imperfectly. In some cases fatty degeneration of the liver and kidneys may be found.

Treatment.—Any soluble sulphate, such as an ounce of magnesium sulphate or half an ounce of sodium sulphate dissolved in half a pint of water, is the natural antidote, because sulphates and carbolic acid form sulphocarbolates in the blood, and these are harmless. Chalk or saccharated lime are excellent antidotes. Before the antidote is given wash out the stomach, or use some very quickly acting emetic, as apomorphine given hypodermically. Give stimulants freely, such as ether or brandy subcutaneously. Apply hot water bottles and blankets if there are any signs of collapse.

SODII SULPHOCARBOLAS.

Sodium Sulphocarbolate. Sodium phenol-para-sulphonate. $C_6H_4OH{\cdot}SO_2ONa,2H_2O$.

SOURCE.—Sulphocarbolic acid is formed by dissolving carbolic acid in an excess of sulphuric acid and converting the phenolsulphonic acid so obtained into a sodium salt.

Characters.—Colourless inodorous prisms, soluble in water.

Dose, 5 to 15 gr.

ZINCI SULPHOCARBOLAS.

Zinc Sulphocarbolate or Zinc phenol-para-sulphonate.
$Zn(OH \cdot C_6H_4SO_3)_2H_2O$.

Source.—Sulphocarbolic acid is formed by adding sulphuric acid to carbolic acid. This is treated with zinc oxide. The zinc sulphocarbolate crystallizes out on evaporation.

Characters.—Colourless crystals, freely soluble in water.

Action and Therapeutics of Sulphocarbolates.

Both these substances are, like carbolic acid, antiseptic, and may be used externally for this purpose. The sodium salt is occasionally given internally in the hope of controlling gastric fermentation. Zinc sulphocarbolate is not given internally.

CREOSOTUM.

Creosote.

Source.—It is obtained by the distillation of wood tar. It consists chiefly of a mixture in variable proportions of guaiacol ($C_7H_8O_2$), creosol ($C_8H_{10}O_2$), and other phenols.

Characters.—A colourless or slightly yellow liquid, with a very strong peculiar odour and a burning taste. *Solubility.* 1 in 150 in water, freely in alcohol, ether, and glacial acetic acid.

Impurity.—Carbolic acid.

Incompatible.—Explodes when mixed with oxide of silver.

Dose, 1 to 5 m. suspended in mucilage, or as a pill with curd soap, or in capsules.

Preparations.

1. **Mistura Creosoti.**—Creosote, 1; spirit of juniper, 1; syrup, 30; water, 450.

Dose, ½ to 1 fl. oz.

2. Unguentum Creosoti.—Creosote, 1; hard paraffin, 4; white soft paraffin, 5.

ACTION AND THERAPEUTICS.

Creosote has the same actions as carbolic acid, and before that was introduced creosote was used externally as a stimulating antiseptic, a parasiticide, and a slight local anæsthetic; and internally it was given for vomiting and for flatulence. Lately it has been much employed in phthisis, and many authors claim considerable success. The dose must be gradually pushed until from 30 ♏ to 60 ♏ are taken at a time. It should be given immediately after meals. The taste may be concealed by putting a few drops in a teaspoonful of rum, but it is best given in capsules. The carbonate (same dose given after meals in capsules) is said to be less liable to cause indigestion. Creosote has also been used as an inhalation with a steam atomizer. An aching tooth may be relieved if it is plugged with cotton wool soaked in creosote.

Guaiacol.—(Not official.)

It is a monomethyl-ether of pyrocatechin.

SOURCE.—The impure form, a colourless liquid, is obtained by the destructive distillation of guaiacum resin; it is contained in and may be extracted from beech creosote (60 to 90 per cent.) (*see* Creosotum and Guaiacum resin). Usually contaminated with creosote and cresylol. Pure guaiacol ($C_7H_8O_2$), crystallizing in colourless prisms, may be obtained synthetically from pyrocatechin.

CHARACTERS.—Both forms are in taste and odour like creosote. Both are insoluble in water, but dissolve readily in alcohol, ether, fats, oils, and glycerin.

Dose, 1 to 5 m. (in a capsule, or dissolved in cod liver oil or in sherry) of the liquid, or **1 to 5 gr.** (in a cachet) of the solid.

ACTION AND THERAPEUTICS.

External.—It is antiseptic. If painted on the skin over an area of 4 to 20 square inches, it reduces a febrile temperature and causes much sweating.

Internal.—It has been much given in phthisis, for it is believed to aid the destruction of the bacilli in the lungs, but although widely used there is no certain evidence that it is beneficial. It is, however, a favourite remedy with many prescribers. The carbonate and the benzoate (**dose** of either, **5 to 10 gr.** in a cachet) have been given internally. They are said to have the same effects as guaiacol, and they do not upset the stomach.

IODOFORMUM.

Iodoform or Tri-iodomethane. CHI_3.

Source.—Heat together alcohol, iodine, potassium carbonate, and water. $C_2H_6O + 4I_2 + 3K_2CO_3 = CHI_3 + KCHO_2 + 5KI + 2H_2O + 3CO_2$.

Characters.—Small, lustrous, lemon-coloured hexagonal crystals, with an odour like seaweed. Slightly soluble in water and alcohol, freely in fixed and volatile oils, ether, and chloroform. It contains 96·7 per cent. of iodine.

Dose, ½ to 3 gr.

Preparations.

1. Suppositoria Iodoformi.—Iodoform, 3 gr.; oil of theobroma, 12 gr. in each.

2. Unguentum Iodoformi. — Iodoform, 1; yellow paraffin ointment, 9.

Action.

External.—Iodoform is **antiseptic** and **disinfectant**, if we may judge by the results obtained in clinical practice; but the experimental evidence that it has no power to hinder the development of *Staphylococcus pyogenes*, *Bacillus subtilis*, and other micro-organisms is very strong, for all except one or two experimenters state that it has not any antiseptic properties. The reason of these discrepancies is this: Iodoform only acts as an antiseptic after its decomposition, which results in the liberation of free iodine. The fats always present in tissues dissolve it. When dissolved it is easily decomposed by many agents, such as light, oxygen, living cells, or ptomaines, which would have no effect on it if it were undissolved. By one or more of these it is, when dissolved after being dusted on a wound, slowly decomposed. Iodine is thus set free rapidly enough to act as an antiseptic, but not rapidly enough to act as an irritant.

Internal.—Not much is known about the internal action of iodoform. It is eliminated in all the secretions, but chiefly in the urine, as iodine, iodides, and iodates. They may be found in the urine for three days after administration of iodoform.

THERAPEUTICS.

External.—Iodoform is much used as a local stimulant, antiseptic, and disinfectant. The clinical testimony to its value is overwhelming.

Its anæsthetic influence diminishes the pain, if there is any, of the sores to which it is applied. It is an excellent application for all sorts of ulcers, sores, and wounds, but especially for tuberculous and syphilitic ulcerations. Iodoform powder is usually sprinkled on them. Wounds are often painted with a solution of it in collodion. This is an excellent application. Mixed with bismuth subnitrate, it is useful as an insufflation for ozæna, ulcers of the mouth and throat, and tuberculous ulcers of the larynx. It has been used in the form of a bougie for the urethra. The suppository is useful in painful conditions of the rectum. It is occasionally employed for pruritus, and to relieve the pain of neuralgia. Many attempts have been made to get rid of its odour; the best way is to dissolve it in volatile oil of camphor or balsam of Peru, or to add musk or 2 per cent. of creolin to it.

Internal.—Iodoform has not been found to be of any use internally. It has been tried unsuccessfully in phthisis and many other conditions.

TOXICOLOGY.

Curious symptoms, often severe and sometimes ending in death, are occasionally observed after the application of iodoform to a raw surface. They are a quick pulse, gastro-intestinal irritation, fever, rapid collapse, melancholia, hallucinations, dilated pupils, extensive erythema, and perhaps eczema. These symptoms vary much in severity, and it is rare for more than two or three of them to be present at once. Fatty degeneration of the liver and muscles may occur. Stimulants, diaphoretics, and sponging the skin with warm water are recommended.

NAPHTHOL.

Beta-naphthol or Beta-mono-hydroxy-naphthalene. $C_{10}H_7OH$.

SOURCE.—Prepared from naphthalene-sulphonic acid.

CHARACTERS AND TESTS.—White shining laminar crystals or in powder. Odour like phenol; taste pungent. *Solubility.*—Easily in alcohol, ether, chloroform, benzene, 1 in 1,000 cold water, 1 in 8 of olive oil, 1 in 80 of vaseline.

Dose, 3 to 10 gr. (in a cachet).

ACTION AND THERAPEUTICS.

Naphthol is a powerful antiseptic. A 10 per cent. ointment cures scabies, and stronger ointments may be used for ringworm. It has also been used for psoriasis. Internally it has been often given as an intestinal antiseptic in typhoid fever and infantile diarrhœa, but it is difficult to say how far the improvement which may follow is due to rest or careful dieting, and it is quite possible that as micro-organisms play a part in healthy digestion, a really efficient intestinal antiseptic might do more harm than good.

Creolin.—(Not official.)

This is a dark liquid derived from coal tar. Jeyes' disinfectant preparations contain it. It is a powerful germicide. It forms a white emulsion with water, is cheap, and has a pleasant smell. Toxic symptoms are known, but are very rare.

Izal and **Lysol.**—(Neither official.)

These are coal-tar derivatives, are powerful antiseptics, are not highly poisonous, and are, when mixed with water (Izal, $\frac{1}{2}$ per cent., Lysol, 2 per cent.), used in surgery.

Formaldehyd.—(Not official.)

CH_2O. A gas. Soluble in water.

The solution, commonly called formalin, containing 35 per cent., is an excellent germicide, especially for ringworm. It preserves specimens, and is useful for all sorts of disinfecting processes. Formalin, 1; water, 500, is an admirable wash for a foul mouth.

CLASS VII.—The Remaining Carbon Compounds.

These have no relationship to each other, and each must therefore be considered separately.

ACIDUM HYDROCYANICUM DILUTUM.

Diluted Hydrocyanic Acid. Hydrogen Cyanide. HCN.
Synonym.—Prussic acid.

SOURCE.—Prepared by the interaction of potassium ferrocyanide and sulphuric acid. The distillate is diluted with water until 100 gr. or 110 ♏ treated with silver nitrate yield 10 gr. of precipitated dried cyanide of silver. It is then a 2 per cent. by weight solution of hydrogen cyanide. Scheele's prussic acid is a 4 or 5 per cent. solution.

CHARACTERS.—A colourless, volatile, faintly acid liquid, having an almond-like odour. Very unstable; to preserve it best it should be kept in a dark place in small inverted amber coloured stoppered bottles. Old specimens may be inert. Sp. gr. 0·997. *Strength.*—**2** per cent.

INCOMPATIBLES.—Salts of silver, copper, and iron, red oxide of mercury, and sulphides.

IMPURITIES.—Sulphuric and hydrochloric acids.

Dose, 2 to 6 m.

Preparation.

Tinctura Chloroformi et Morphinæ Composita.—$\frac{1}{2}$ ♏ of Acidum Hydrocyanicum Dilutum in 10 ♏. (*See* p. 262.)

Dose, 5 to 15 m.

Hydrocyanic acid is contained in Aqua Laurocerasi, and also in oil of bitter almonds (non-official). It is probably the active ingredient of the preparations of Virginian Prune.

ACTION.

External.—Hydrocyanic acid can pass through the epidermis, and then it paralyses the terminations of the sensory nerves; thus it is a **local anæsthetic and sedative.** It is very rapidly absorbed from raw surfaces, and may cause poisoning if applied to them.

Internal.—*Alimentary tract.*—It is quickly absorbed by mucous membranes, and has the same anæsthetic and sedative effect on the mouth and stomach as on the skin. It must always be employed very dilute. A single drop of the pure acid placed inside the eye of even a moderately large animal will kill it instantly.

Blood.—If death takes place almost immediately after the administration of the drug, all the blood in the body is of a bright arterial tint; but if death does not occur for some little time (within half an hour), the blood is of a dark venous colour. The primary transitory reddening of the venous blood is due to the fact that the hæmoglobin in it is oxidized; we do not know the cause of this. The subsequent darkening of the arterial blood is due to the fact that it has lost its oxygen, and contains carbonic acid gas; why this should be is not certain, but probably it depends upon the asphyxia consequent upon the action of hydrocyanic acid on the respiratory centre. If blood be shaken up with prussic acid, after some time oxyhæmoglobin is converted into cyanohæmoglobin, the oxygen being turned out. Prussic acid added to drawn blood alters the shape of the red blood-corpuscles. Neither of these actions is seen in life, for sufficient prussic acid to cause them would kill before they could take place.

Heart.—Large doses cause instantaneous **diastolic arrest.** As this is also true if the drug is applied locally, wo may conclude that large doses paralyse the heart directly. But prussic acid acts also on the cardiac centre in the medulla. A small dose will cause a slowing of the pulse from stimulation of the vagus centre, and the stoppage from larger doses is due both to the direct action on the heart and to that on the medulla.

Vaso-motor system.—The vaso-motor centre in the medulla is first briefly stimulated, but soon profoundly **paralysed**; **blood-pressure** therefore falls **very low.**

Respiration.—The respiratory centre is **paralysed** even more readily than the cardiac or vaso-motor centres, consequently the respirations quickly diminish both in force and frequency. Unless the heart has been instantaneously stopped by a large dose, asphyxia is the cause of death, and the heart goes on beating after the respirations have stopped. Occasionally, if the dose be small, all three centres may be at first very transitorily stimulated, so that for a few seconds the pulse and respirations may be increased in frequency, and blood-pressure may rise.

Nervous system.—Cerebrum.—Medicinal doses of prussic acid have no effect on the cerebrum. Toxic doses cause deep insensibility and coma. In man convulsions are rarely seen; in animals they are common. It is probable that the coma and convulsions are due to the direct effect on the brain, but they may in part be due to the altered circulation through it, or to the asphyxia.

Peripheral nerves and muscles.—In animals dead of prussic acid poisoning these are unexcitable. This paralysing effect is due to a direct action on the nerves and muscles themselves, for it does not occur in the peripheral part of a limb if it is connected with the rest of the body only by its nerve. In this case, as no blood is circulating through the distal part of the limb, no prussic acid reaches it; but if the acid be applied locally to the severed limb, the nerve and muscles are paralysed. This explains the local anæsthetic effect of prussic acid.

Shortly before death the spinal cord is paralysed. The pupil is dilated. We do not know of any effect of prussic acid on the kidneys, nor how it is excreted. It slightly reduces the temperature.

THERAPEUTICS.

External.—Lotions of a strength of about ♏x of the diluted acid to 1 fl. oz. of water are valuable for allaying itching due to any cause. If the skin is abraded they must not be used.

Internal.—Small doses, 2 to 4 ♏ of the diluted acid, are used for their sedative effect on the nerves of the stomach, to allay vomiting, and to relieve gastric pain, whatever may be their cause, and often with good effect. A useful way of giving it is in an effervescing draught. It is a common ingredient of cough mixtures for by its depressing effect on the central nervous system it diminishes reflex excitability, and is consequently most serviceable for a dry hacking cough, by means of which nothing is expectorated.

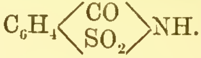
TOXICOLOGY.

With a large dose the symptoms usually begin in a few seconds; it is rare for them to be delayed more than two minutes. The patient is perfectly insensible, the eyes are fixed and glistening, the pupils dilated, the limbs flaccid, the skin cold and clammy. The respiration is slow, deep, and convulsive; the pulse is almost imperceptible. *Post mortem.*—There may be an odour of prussic acid about the body, which is very livid. The fingers are clenched, the jaws firmly closed, and there is froth at the mouth; the eyes are fixed and glistening, and the pupils are dilated. The stomach may be a little reddened. The blood is very dark.

Treatment.—Wash out the stomach immediately. If emetics are available large doses must be given very promptly, for every moment is important. Give ether or brandy and $\frac{1}{50}$ gr. of atropine subcutaneously. Use inhalations of ammonia and artificial respiration.

GLUSIDUM.

Gluside. Benzoyl-sulphonimide. C_6H_4,CO,SO_2NH.
Synonyms.—Glucusimide, Saccharin.



$$C_6H_4\left\langle\begin{matrix}CO\\SO_2\end{matrix}\right\rangle NH.$$

Source.—It is derived from toluene C_6H_5,CH_3, a derivative of coal tar, by a complicated process.

Characters.—A light, white, minute crystalline powder. Its solution has an intensely sweet taste; 1 of saccharin is equal to 300 of cane sugar. *Solubility.*—1 in 400 of cold water; 1 in 24 of boiling water; 1 in 500 of chloroform; 1 in 25 of alcohol (90 per cent.); 1 in 48 of glycerin. It unites with alkaline hydrates and carbonates, evolving from the latter carbonic acid gas, and yielding soluble saccharin, which has lost none of its sweetness, and is very soluble in water.

Impurities.—Commercial saccharin is not a pure or uniform product; it often contains less than 50 per cent. of actual glusidum.

Dose, $\frac{1}{2}$ to 2 gr.

Action and Therapeutics.

Glusidum is an antiseptic, but is not used as such. It is employed as a **sweetening agent** when from any cause, as diabetes, sugar cannot be taken. It may be given as tablets or with sodium carbonate to form soluble saccharin.

PARAFFINUM LIQUIDUM.

Liquid Paraffin.

Source.—Obtained from petroleum after the more volatile portions have been removed by distillation.

Characters.—A colourless, odourless, tasteless clear oily liquid. Sp. gr. 0·885 to 0·890.

PARAFFINUM DURUM.

Hard Paraffin.

Source.—Obtained by distillation from shale and separation of the liquid oils by cooling, pressure, and purification.

Characters.—A semi-transparent, colourless, crystalline, inodorous, tasteless solid, slightly greasy to the touch. Melts at 110° to 145° F., burns with a bright flame. Sp. gr. 0·82 to 0·94. *Solubility.*—Freely in ether and chloroform; slightly in alcohol; not at all in water. It is a mixture of several of the harder members of the paraffin series.

PARAFFINUM MOLLE.

Soft Paraffin. *Synonym.*—Vaseline.

Source.—Usually obtained by purifying the less volatile portions of petroleum.

Characters.—A white or yellowish, translucent, soft and greasy semi-solid mixture of the soft members of the paraffin series of hydrocarbons, free from acidity, alkalinity, or any unpleasant odour or flavour. Melts at 95° to 102° F. Insoluble in water.

Preparation.

Unguentum Paraffini.—Hard Paraffin, 3; Soft Paraffin, 7. When paraffin ointment is the basis of white ointments, it should be made from white soft paraffin; when it is the basis of coloured ointments it should be made from yellow soft paraffin. In order to meet the exigencies of climate and temperature the proportion of hard and soft paraffin may be varied.

Uses.

As paraffin cannot become rancid, or irritate the skin, it is a very good basis for many ointments; but as it is absorbed with difficulty, it is not a suitable vehicle for the absorption of drugs by the skin.

BENZOL.

A mixture of homologous hydrocarbons obtained from light coal-tar oil. It contains about 70 per cent. of benzene, C_6H_6, and 20 to 30 per cent. toluene, C_6H_5,CH_3.

Characters.—A colourless volatile liquid free from opalescence, with strong characteristic odour. Sp. gr. 0·88 to 0·888.

Uses.

Used to make Liquor Caoutchouc and Charta Sinapis.

CARBONIS BISULPHIDUM.

Carbon Bisulphide. CS_2.

Source.—May be prepared by combining carbon and sulphur at a high temperature.

Characters.—Clear, colourless, highly refractive liquid, with characteristic odour. Sp. gr. 1·268 to 1·269. Very slightly soluble in water, but soluble in alcohol, ether, chloroform, fixed and volatile oils.

Uses.

Used to make Liquor Caoutchouc and Pilula Phosphori.

PART II.—ORGANIC MATERIA MEDICA.

SECTION I.—PHARMACOPŒIAL SUBSTANCES DERIVED FROM THE VEGETABLE KINGDOM.

THE drugs comprehended in this section may be arranged in many ways, but there are objections to each. Inasmuch as the medical student has to be well acquainted with the actions of these drugs in health and disease, those which act similarly will be grouped together, In the Appendix a list of these drugs, arranged according to their Natural Orders, will be found.

GROUP I.

Drugs acting chiefly on the Nervous System.

These may be classified as follows
CLASS I.—Acting on the cerebrum.
  A. Cerebral depressants or soporifics:
    Opium. Hop. Lettuce.

  B. Cerebral excitants:
    Deliriants:
      Belladonna.
      Stramonium.
      Hyoscyamus.
        (Also act on nerve endings in glands and involuntary muscle.)
      Cannabis Indica.
    Caffeine.

CLASS II.—Acting on the spinal cord.
  A. Exciting the cells of the anterior cornua. **Strychnine.**
  B. Depressing the cells of the anterior cornua. **Calabar bean, Gelsemium.**

CLASS III.—Acting on the nerves.
  A. Depressing the motor nerves. **Conium, Nicotine.**
  B. Depressing the sensory nerves. **Cocaine.**
  C. Stimulating the secretory nerves. **Jaborandi.**
  D. Depressing the motor end plates. **Curare.**

CLASS I.—Vegetable Drugs acting chiefly on the Cerebrum.

POPPY CAPSULES.

Papaveris Capsulæ.—The nearly ripe, dried fruit of *Papaver somniferum*, the white poppy (Nat. Ord. *Papaveraceæ*).

CHARACTERS.—Globular, 2 to 3 in. in diameter. Crowned by stellately arranged stigmas. Yellowish brown with blackish spots. Internally a number of thin, brittle, parietal placentas, with many loose, small, reniform, whitish, slate-coloured, or nearly black seeds. Inodorous, slightly bitter.

COMPOSITION.—A little opium in the capsules, and some oil in the seeds.

ACTION AND USES.

A warm decoction is used locally as an anodyne fomentation. Preparations of poppy capsules are unsuitable for internal use, as the amount of opium they contain is small and uncertain.

OPIUM.

Opium.—The juice obtained by incision into the unripe capsules of *Papaver somniferum*, the white poppy (Nat. Ord. *Papaveraceæ*), inspissated by spontaneous evaporation. Any suitable variety of opium may be used to obtain the liquid extract and the tincture of their respective alkaloidal strengths, provided that when dry it contains not less than 7½ per cent. of anhydrous morphine ; but otherwise the preparations of opium must be made from opium of such a strength that when dried and powdered it shall yield from 9·5 to 10·5 *per cent. of morphine*. Opium containing more morphine may be diluted to that strength by the addition of opium containing between 7 and 10 per cent. of morphine or by milk sugar.

CHARACTERS.—*Asia Minor opium* (*Synonyms.*—Smyrna, Turkey, and Levant opium) is the variety most frequently seen. Rounded, irregular, or flattened masses, commonly from 8 oz. to 2 lbs. in weight, usually covered with portions of poppy leaves, and scattered over with reddish-brown chaffy fruits of a species of *Rumex*. When fresh it is plastic, moist, coarsely granular, reddish or chestnut-brown, but becoming harder by keeping, and darkening to blackish brown. Odour strong, peculiar, narcotic. Taste nauseously bitter. A fluid preparation reddens litmus paper, owing to the presence of meconic acid.

Varieties.—In addition to Asia Minor opium the following are met with in commerce. (*a*) Constantinople opium, small lenticular masses, ¼ to ½ lb. in weight, and enclosed in a poppy leaf, but without the *Rumex* seeds. Sometimes the terms Turkey and Levant opium include this. (*b*) Egyptian opium. Flat, more or less circular cakes, two or three inches in diameter, reddish hue internally, covered with a leaf externally. Persian, Indian, English, French, and German opiums are rarely met with in England.

Composition.—(1) *Alkaloids.*—At least eighteen in number. Most are combined with meconic acid, some with sulphuric acid, and some are free. Some morphine salts and codeine and its phosphate are official. Morphine, codeine, narcotine, and thebaine are important. The following are the alkaloids existing in opium :

Morphine (up to 12 per cent.).
Codeine (up to ·6 per cent.).
Thebaine (up to ·3 per cent.).
Narcotine (also called Anarcotine).
Narceine.
Papaverine.
Pseudo-morphine.
Protopine.
Oxynarcotine.
Cryptopine.
Hydroctarnine.
Laudanine.
Laudanosine.
Meconidine.
Rhœadine.
Codamine.
Gnoscopine.
Lanthoptine.

(2) *Neutral bodies.*—Two in number :

Meconin.
Meconiasin.

(3) *Organic acids.*—Two in number.

Meconic acid.
Thebolactic acid.

(4) *Water*, 16 *per cent.*

(5) *Mucilage, resin, albumen, glucose, fats, essential oil, caoutchouc, odorous substances, and salts of ammonium, calcium, and magnesium.*

The following analysis shows how specimens vary. Two specimens yielded :

	Morphine per cent.	Anarcotine per cent.
Patna opium	3·98	6·36
Smyrna opium	8·27	1·94

Impurities.—Water, stones, fruits, leaves, starch, &c. 100 gr. dried at 212° F. should yield **9·5 to 10·5 gr. of morphine.**

INCOMPATIBLES.—Perchloride of iron gives a deep red colour (due to meconic acid). Salts of zinc, copper, and arsenic, silver nitrate, acetate and subacetate of lead, give precipitates of meconates, sulphates, and colouring matters. All tannin-containing preparations precipitate codeine tannate. Fixed alkalies, their carbonates, and ammonia precipitate morphine and narcotine. The small amount of glucose in opium may cause it to explode when made into a pill with nitrate of silver.

Dose, ½ to 2 gr.

Preparations.

1. **Emplastrum Opii.**—Powdered opium, 1; resin plaster, 9. *Strength of opium.*—1 in 10. (Very little used.)

2. **Extractum Opii.**—Sliced opium, distilled water. *Strength of opium.*—2 in 1. *Standardized to contain* 20 *per cent. of morphine.* (To obtain the correct strength, stronger and weaker extracts may be mixed, or stronger diluted with water or sugar of milk.)

Dose, ¼ to 1 gr.

3. **Extractum Opii Liquidum.**—Extract of opium, ¾; water, 16; alcohol (90 per cent.), 4. *Strength of opium.*—1 in 14 (1 gr. in 15 ♏). *Standardized to contain* 0·75 *per cent. of morphine.* (Official imitation of Liquor Opii Sedativus or Battley's Sedative Solution.)

Dose, 5 to 30 m.

4. **Pilula Plumbi cum Opio.**—Powdered opium, 1; lead acetate, 6; syrup of glucose, ⅔. *Strength of opium.*—1 in 8.

Dose, 2 to 4 gr.

5. **Pilula Saponis Composita.**—Powdered opium, 1; hard soap, 3; syrup of glucose, 1. *Strength of opium.*—1 in 5. (Often called Pilula Opii.)

Dose, 2 to 4 gr.

6. **Pulvis Cretæ Aromaticus cum Opio.**—Powdered opium, 1; aromatic chalk powder, 39. *Strength of opium.*—1 in 40.

Dose, 10 to 40 gr.

7. **Pulvis Ipecacuanhæ Compositus.** *Synonym.*—Dover's powder. Powdered opium, 1; ipecacuanha, 1; potassium sulphate, 8. *Strength of opium.*—1 in 10.

Dose, 5 to 15 gr.

8. Pilula Ipecacuanhæ cum Scillâ.—Compound ipecacuanha powder, 3 ; squill, 1 ; ammoniacum, 1 ; syrup of glucose, q. s. *Strength of opium.*—1 in 20.
Dose, 4 to 8 gr.

9. Pulvis Kino Compositus. — Powdered opium, 1 ; kino, 15 ; cinnamon, 4. *Strength of opium.*—1 in 20.

Dose, 5 to 20 gr.

10. Pulvis Opii Compositus. — Powdered opium, 3 ; black pepper, 4 ; ginger, 10 ; caraway, 12 ; tragacanth, 1. *Strength of opium.*—1 in 10.
Dose, 2 to 10 gr.

11. Suppositoria Plumbi Composita.—Powdered opium, 1 ; lead acetate, 3 ; oil of theobroma, 11. *Strength of opium.*—1 gr. in each.

12. Tinctura Opii. *Synonym.* — Laudanum. Powdered opium, 3 oz. ; alcohol (90 per cent.), and water, equal parts. *Standardized to contain* 0·75 *per cent. of anhydrous morphine. Strength of opium.*—On the average 32·8 grains (containing 10 per cent. morphine) in 1 fl. oz., that is, 1 in 13½ (1 gr. in 15 ♏).

A preparation of opium called Nepenthe is the same strength as Tinctura Opii. Sydenham's laudanum is a tincture of opium flavoured with saffron. Acetum Opii Crocatum (black drop) is four times as strong as Tinctura Opii.

Dose, 5 to 15 m. for repeated, **20** to **30 m.** for single administration.

13. Linimentum Opii.—Tincture of opium and soap liniment, equal parts. *Strength of opium.*—1 in 27.

14. Tinctura Camphoræ Composita. *Synonym.*—Paregoric. Tincture of opium, 585 ♏ ; benzoic acid, 40 gr. ; camphor, 30 gr. ; oil of anise, 30 ♏ ; alcohol (60 per cent.) to make 20 fl. oz. *Strength of opium.*—2 gr. (containing 10 per cent. morphine) in 1 fl. oz. : that is, 1 in 219 (1 gr. in 240 ♏).
Dose, 30 to 60 m.

15. Tinctura Opii Ammoniata. *Synonym.*—Scotch paregoric. Dissolve benzoic acid, 180 gr., and oil of anise, 1 fl. dr. in alcohol (90 per cent.), 12 fl. oz. Add tincture of opium, 3 fl. oz., strong solution of ammonia 4 fl. oz., and alcohol (90 per cent.) to make

1 pint. *Strength of opium.*—5 gr. (containing 10 per cent. morphine) in 1 fl. oz., or 1 in 88 (1 gr. in 96 ♏).

Dose, 30 to 60 ♏.

16. Unguentum Gallæ cum Opio.—Powdered opium, 7½; ointment of galls, 92½. *Strength of opium.*—1 in 12⅓.

It will be noticed that—

From *Extractum Opii* there is prepared Extractum Opii Liquidum.

From *Pulvis Ipecacuanhæ Compositus* there is prepared Pilula Ipecacuanhæ cum Scillâ.

From *Tinctura Opii* there are prepared Linimentum Opii, Tinctura Camphoræ Composita, and Tinctura Opii Ammoniata.

The following list, in which the doses are arranged approximately according to those given in the Pharmacopœia, may assist the student.

Strength of Opium.	*Name.*	*Approximate Dose.*
1 in ½	Ext. Opii . . .	¼—1 gr.
1 in 5	Pil. Saponis Co.	2—4 gr.
1 in 8	Pil. Plumbi c̄ Opio	
1 in 10	Pulv. Opii Co.	2—10 gr.
1 in 20	Pil. Ipecac. c̄ Scilla	
1 in 10	Pulv. Ipecac. Co.	5—20 gr. or ♏.
1 in 13½	Tinct. Opii	
1 in 14	Ext. Opii Liq.	
1 in 20	Pulv. Kino Co.	
1 in 40	Pulv. Cret. Aromat c̄ O.	10—40 gr.
1 in 88	Tinct. Opii Ammon.	30—60 ♏.
1 in 219	Tinct. Camph. Co.	
1 gr. in each	Suppositoria Plumbi Co.	
1 in 10	Emplast. Opii.	
1 in 12⅓	Ung. Gallæ c̄ Opio.	
1 in 27	Linimentum Opii.	

Morphinæ Hydrochloridum. — Morphine Hydrochloride. $C_{17}H_{19}NO_3,HCl,3H_2O$. Called hydrochlorate of morphine, B. P. 1885.

Source.—(1st) Take a cold concentrated watery solution of opium, precipitate the meconic acid and resins with calcium chloride. The solution contains hydrochloride of morphine. (2nd) Evaporate the solution till it is solid, press to remove colouring matter, exhaust with boiling water, filter, and again evaporate and press; repeat this till the solution is nearly colourless. (3rd) Complete the decolorization by digesting with charcoal. (4th) Precipitate the morphine with ammonia and wash. (5th) Dissolve in hydrochloric acid and crystallize out.

Characters.—White acicular, silky prisms or a white powder of minute cubical crystals. *Solubility.*—1 in 24 of water; 1 in 50 of alcohol (90 per cent.); 1 in 8 of glycerin.

Incompatibles.—Salts of lead, iron, copper, mercury, and zinc; alkaline carbonates; lime water; Liquor Arsenicalis; all substances containing tannin.

Dose, $\frac{1}{8}$ to $\frac{1}{2}$ gr.

Preparations.

1. **Liquor Morphinæ Hydrochloridi.**—Morphine Hydrochloride, 17½ gr.; dilute hydrochloric acid, 38 ♏; alcohol (90 per cent.), 1 fl. oz.; water, to make 4 fl. oz. *Strength.*—1 per cent. or 1 gr. in 110 ♏, or about 4½ gr. of the hydrochloride to 1 fl. oz.
Dose, 10 to 60 m.

2. **Suppositoria Morphinæ.**—Morphine Hydrochloride, ¼ gr.; oil of theobroma, 14½ gr. *Strength.*—1 in 60 (¼ gr. in each).

3. **Tinctura Chloroformi et Morphinæ Composita.**—*See* p. 262. *Strength.*—$\frac{1}{11}$ gr. in 10 ♏.
Dose, 5 to 15 m.

4. **Trochiscus Morphinæ.**—Morphine Hydrochloride, $\frac{1}{36}$ gr.; with tolu basis. *Strength.*—$\frac{1}{36}$ gr. in each.

5. **Trochiscus Morphinæ et Ipecacuanhæ.**—Morphine Hydrochloride, $\frac{1}{36}$ gr.; ipecacuanha, $\frac{1}{12}$ gr.; with a tolu basis. *Strength.*—$\frac{1}{36}$ gr. in each.

Morphinæ Acetas.—Morphine Acetate. $C_{17}H_{19}NO_3,C_2H_4O_2,3H_2O$. The use of the acetate is diminishing, as it is unstable, losing acetic acid on exposure to air.

Source.—Morphine is dissolved in acetic acid and water, and the neutral solution is evaporated.

Characters.—A white crystalline or amorphous powder.

Solubility.—1 in 2½ of water. Many specimens are not so soluble as this. 1 in 100 of alcohol (90 per cent.); 1 in 5 of glycerin.

Dose, ⅛ to ½ gr.

Preparation.

Liquor Morphinæ Acetatis.—Morphine Acetate, 17½ gr.; dilute acetic acid, 38 ♏; alcohol (90 per cent.), 1 fl. oz.; distilled water, to make 4 fl. oz. *Strength.*—1 per cent. or 1 gr. in 110 ♏, or about 4½ gr. of the acetate to 1 fl. oz.

Dose, 10 to 60 m.

Morphinæ Tartras.—Morphine Tartrate $(C_{17}H_{19}NO_3)_2,C_4H_6O_6,3H_2O$.

SOURCE.—May be obtained by the combination of morphine and tartaric acid.

CHARACTERS.—A white powder consisting of tufts of minute acicular crystals. *Solubility.*—1 in 11 of cold water, not in alcohol.

Dose, ⅛ to ½ gr.

Preparations.

1. Injectio Morphinæ Hypodermica.—solve 50 gr. of morphine tartrate in 1100 ♏ of boiled, cooled water. *Strength.*—22 ♏ contain 1 gr., that is 5 per cent. of morphine tartrate.

The morphine strength of this is slightly less than half that of B. P. 1885.

Dose, 2 to 5 m. subcutaneously.

2. Liquor Morphinæ Tartratis. — Morphine Tartrate, 17½ gr.; alcohol (90 per cent.), 1 fl. oz.; water, 3 fl. oz. *Strength.*—1 per cent., or 1 gr. in 110 ♏, or about 4½ gr. of the tartrate to 1 fl. oz.

Dose, 10 to 60 m.

ACTION.

The action and uses of opium are due almost entirely to its morphine, and therefore they may be studied together. For Codeine *see* p. 326.

External.—Opium probably has no action when applied to the unbroken skin, but it has been said to be slightly anodyne. It can be absorbed from and relieve the pain of raw surfaces.

Internal.—*Alimentary canal.*—Opium diminishes all the **secretions** of the body except the sweat. The mouth consequently becomes dry, and the patient feels thirsty, but after a small dose not markedly so. This effect is partly due to the direct action of the opium on the mouth, but to a less extent to its influence exerted after it has been absorbed. In the stomach and intestine, by the same double action, the secretion of the gastric and intestinal juices is diminished. The drug also paralyses the peristaltic movements of the stomach and intestines. This is due to its action on the nervous or muscular structures in the wall of the intestine itself. The result of the diminution of secretion and peristalsis is that opium appeases hunger, often causes **indigestion**, almost always gives rise to **constipation**, and if vomiting or diarrhœa is present it may prevent it. These actions are also in part due to its general sedative influence on the nervous system. If pain exists in the abdomen or elsewhere opium is a powerful **anodyne**. Most of it is absorbed, but rather slowly. If injected subcutaneously it is excreted into the stomach. With some persons it causes **vomiting**.

Blood.—Morphine for the most part circulates in the blood as such, and is excreted by the kidneys, but a small part of it is destroyed in the liver. The fate of the other alkaloids is not known, nor are we aware of any direct action of any of the constituents of opium on the blood itself.

Circulation.—In an ordinary healthy man small doses of opium do not affect the heart or vessels. Large doses first increase and then diminish the action of the heart, which finally stops in diastole. These effects can be produced by applying the drug to the organ; it therefore directly affects either the cardiac muscle or the nerves in it. But this local action is augmented by the less important influence of opium on the vagal centre; this is at first stimulated, and about the time at which the heart itself is depressed, so that both these actions make the **pulse slow.** Just before death the vagus is depressed, but the heart itself is by then so feeble that the pulse is not quickened. Patients rarely die from the effect of opium on the heart and its nervous apparatus, this being much less important than the influence on respiration.

The vaso-motor system is not affected till towards the end of the symptoms due to toxic doses; then the vessels dilate from the action of the drug on the vaso-motor centres in the medulla and cord.

Respiration.—Opium is a **direct poison** to the **respiratory centre.** Breathing therefore becomes slow, less air is taken in at each inspiration, and death takes place from **asphyxia.**

Nervous system.—Brain.—The **higher faculties** are at first **excited** even by small doses. In a few persons there is no incoordination in this excitement. The intellectual power and mental vigour are increased, and therefore the drug is taken by some people to enable them to do their mental work. Usually, however, the excitation does not affect the mind evenly; generally the imagination is powerfully and pleasantly excited, much more so than the faculties of reason and judgment, which are a little dulled. The expression on the face is one of happiness and comfort, and this corresponds with the condition of mind, which is in a state of peace, calm, and happiness. This is soon succeeded by **sleep,** which is accompanied by pleasant dreams, generally of an impossible nature. With some persons, however, the sleep is quite dreamless. This, which is the beginning of the depression of the highest centres, is soon followed by depression of the others, the higher being influenced before the lower, so that soon the sleeper does not respond to any sound, light, or cutaneous stimulation, **nor does he feel pain.** It is this last fact that makes the drug so invaluable.

The dose requisite to annul pain depends, of course, upon the severity of it. If a large amount is given, often there is no primary excitement, and then the first symptom that opium has been taken is drowsiness. On waking from sleep induced by opium some persons feel quite well, but usually there is a little languor, headache, and nausea. Opium eaters take it for its stimulant effect. It is given medicinally as an hypnotic and anodyne. The **pupil is contracted**; this is due to the effect of the drug on the pupillary centre in the floor of the aqueduct of Sylvius. In man, just as the stimulation of the intellectual centres is brief, so is that of the cerebral motor centres—in fact, it is often difficult to detect any evidence of it. Their subsequent depression is never so marked as that of the intellectual faculties; for although there is languor and muscular weakness, and the patient always lies down, yet he can be walked about if he is supported. Vomiting is occasionally caused by transient irritation of the vomiting centre, but soon this is depressed, and therefore emetics do not act well in cases of opium poisoning.

The motor cells of the **spinal cord** are at first slightly stimulated, and consequently reflex excitability is exaggerated; but they are soon **depressed**, and it is difficult to obtain reflex movements.

The excitability of motor and sensory nerves is, perhaps, a little increased at first, but in the later stages of opium poisoning they are depressed, the sensory before the motor. The muscles remain irritable to the last.

Opium, in its action on the nervous system, illustrates the common fact that functions at first stimulated by a drug are usually subsequently paralysed by it; and it affords an excellent example of the law of dissolution, for higher functions, such as the intellectual and imaginative, are first affected; motion is then disordered; next the pupillary centre, and then the medullary centres for respiration and cardiac action are implicated. The spinal cord is influenced to a less degree, the nerves very slightly, and the muscles not at all.

In **man** the peculiarities of the action of morphine are its predominating influence on the higher mental functions, and the slight affection of the motor and the vaso-motor centres, the cord, the nerves, and the muscles. In **frogs** morphine produces violent convulsions, because its predominating action is to stimulate the spinal cord. **Birds** are peculiarly insusceptible to morphine. **Mammals** are for the most part affected in the same way as man; dogs and rabbits require large doses to produce symptoms, and with cats morphine is a violent convulsant.

Kidneys.—Sometimes opium slightly increases, sometimes it slightly decreases, the urinary flow.

Skin.—Opium is a mild **diaphoretic.** It may cause itching.

Metabolism.—If the person taking it has glycosuria, the amount of sugar he passes in the urine is diminished. General metabolism appears to be decreased also, for it is stated that the amounts of uric acid and carbonic acid excreted are lessened, but some experimenters contradict this statement.

Temperature.—Large doses depress this, probably from the effect of the drug on the thermogenetic nerve centres.

Peculiarities.—There are few drugs which have such different effects upon different people. The above description states the manner in which most human beings are affected, but in some the stage of excitation is very evident, so that they become delirious and cannot sleep. In others, vomiting and indigestion are very marked. Some of these peculiarities are due, no doubt, to the varying composition of opium. **Children** are easily poisoned by it, and therefore only **small doses** should be administered to them; women are more readily affected than men. Persons who take it habitually soon tolerate enormous quantities. It may produce an erythematous eruption on the skin.

Differences in action between opium and morphine.—(1) Morphine, being more readily absorbed, acts more quickly. It is especially suited for subcutaneous injection; given in this way it acts very rapidly. (2) Opium is more liable to upset the digestion and to cause constipation, but this last fact often makes it the more valuable in many abdominal diseases. (3) Opium is the better diaphoretic. (4) Morphine is more certain in its action as an anodyne and soporific; possibly this is because of the other powerful alkaloids in opium. (5) Opium is stated to act more powerfully in reducing the amount of sugar present in the urine in glycosuria.

THERAPEUTICS.

External.—Hot fomentations or poultices sprinkled with laudanum are often applied to painful parts, but probably it is the heat and not the opium which relieves the pain. Linimentum Opii rubbed into the skin diminishes the pain of chronic rheumatism and myalgia; probably in this case the friction is more efficacious than the opium. Locally applied to sores and ulcers, it may soothe the pain due to them. The ointment of galls and opium will often relieve the pain of piles and anal fissures, especially if a mild laxative is given by the mouth.

Internal.—*Stomach.*—Morphine is of great service for the pain of gastric ulcer, cancer, or even for simple painful dyspepsia. One of the official solutions of morphine (20 ♏ doses) is preferable to opium, as that may aggravate the indigestion. They are frequently combined with preparations of bismuth, and taken immediately before or after meals. Many forms of vomiting are relieved by morphine, because it decreases pain, peristalsis, and excessive secretion.

Intestines.—Opium is invaluable for stopping many varieties of diarrhœa. If they will yield to any treatment, opium is most likely to be successful. Intestinal colic, being due to irregular excessive peristaltic action, is generally relieved by opium—and, indeed, so is abdominal pain of all sorts. In all inflammatory conditions of the peritoneum full doses of opium must be given, the object being so to paralyse the intestinal movements as to prevent the peritoneal surfaces rubbing against each other. It is the great mainstay in appendicitis, acute peritonitis, and after operations or wounds in the abdomen. Opium is preferable to morphine for abdominal cases; if they are severe it must be boldly pushed, the patient being kept just drowsy with slightly contracted pupils, and it often does not matter if the bowels are not open for a week or even more.

Heart.—Much skill is required to give opium properly in heart disease. The hypodermic injection of morphine is, on the whole, to be preferred to opium. The great indication for it is when cardiac pain and distress keep the patient awake. Often it acts like a charm, a quiet refreshing sleep being the result of a single injection. No doubt it is a cardiac depressant, but we have to set against this the exhaustion of pain and insomnia. Still, if the patient is very ill, these two factors must be carefully balanced. It likewise often relieves the pain of aneurysm and intra-thoracic growths. Its depressant effect may be to some extent counterbalanced by combining belladonna with it.

Vessels.—Opium is an excellent hæmostatic. It is probably efficient after absorption, but its great value is in intestinal hæmorrhage, when it acts partly by stopping peristaltic movements. An excellent form in which to give it is the Pilula Plumbi cum Opio.

Respiration.—It will be remembered that opium depresses the respiratory centre; therefore it, by diminishing the activity of the centre for the reflex act of coughing, will often alleviate this distressing symptom, but it is only justifiable to give it when the irritation which reflexly sets up a cough is irremovable, as in intra-thoracic growth or aneurysm, or when there is little or no lividity and yet the cough is violent, as is often the case in pleurisy. The liability to lividity and asphyxia in many diseases attended with cough must never be forgotten. Thus opium is quite inadmissible in the last stages of bronchitis and pneumonia, and, as a rule, in even the earlier stages of bronchitis other means of relieving the cough should be tried first; and if opium is given, it must be administered with caution and judgment. A "linctus opiatus," a favourite remedy, is often given at night when a cough keeps the patient awake. It may consist of tincture of opium, 2 ♏; dilute sulphuric acid, 2 ♏; treacle, 30 ♏; water to 1 fl. dr. The object of the treacle is to soothe the pharynx locally. Opium must also be given cautiously for asthma, as there is in this disease a great liability to the growth of a permanent opium habit.

Nervous system.—Brain.—It is in its action on this organ that the marvellous value of opium is seen, its great function being to relieve pain and to produce sleep when that is prevented by pain. For these purposes it is best given hypodermically as morphine, for that acts more quickly, more certainly, and is less liable to produce indigestion and excitement than opium. It would be a long list to give all the diseases the pain of which can be relieved by morphine; cancer and fractures are typical instances. Morphine is very valuable for the insomnia of acute diseases; but it should never be prescribed for habitual sleeplessness, for fear the patient should contract the habit of opium taking—unless the disease causing the insomnia is incurable and will not last long, when the use of opium is quite justified. It should not be given in gout, for that is often accompanied by granular kidneys; nor for hysteria, for often it does not relieve hysterical pains, and an opium habit may be formed. It is especially useful in renal and biliary colic, and for the after-pains of a confinement. In these cases it relieves the pain partly from its power as an anodyne, and also because by its paralysing effect on unstriped muscle it relaxes the muscular contraction. This property also makes it valuable in some cases of spasmodic stricture of the urethra. It may be given as a sedative in delirium tremens and some forms of mania, but often such large doses are required that its use is not justifiable. Patients suffering great pain can take enormous doses without any symptoms of poisoning.

Spinal cord.—It has been used for the pains of locomotor ataxy, and occasionally in convulsive diseases, but without much success.

Kidneys.—It should always be remembered that morphine is excreted with great difficulty if the kidneys are diseased. There are several cases recorded in which persons suffering from Bright's disease have been killed by quite small doses of opium.

Skin.—Combined with ipecacuanha as Dover's powder, opium is commonly given as a mild diaphoretic in cases of slight inflammatory disorder, such as a common cold.

Metabolism.—Opium is administered to persons suffering from diabetes, and the amount of sugar in the urine certainly diminishes and the patient's general health improves. Opium can, in the opinion of many, control all varieties of inflammation; therefore it is given for a cold in the head, for cystitis, pleurisy, &c. Occasionally persons taking opium suffer from retention of urine. We have indicated the occasions on which opium and morphine are respectively preferable.

TOXICOLOGY.

Acute poisoning.—There may be slight preliminary excitability, but soon drowsiness sets in; this is followed by incapacity for exertion, sleep, and finally deep coma. The pupils are minutely contracted. At first the patient can be roused, but soon no stimulation will do this. Reflex action is abolished. The skin is cold, the face and lips are livid, and towards the end bathed in sweat. The pulse is weak and slow. The respiration becomes slower and more irregular, at last it is stertorous, and the patient dies from asphyxia.

Diagnosis of poisoning by opium.—**(1)** *From alcoholic poisoning.*—Often very difficult, especially if, as commonly happens, the man poisoned with opium has taken alcohol or had it given him. The pupils are more contracted in opium poisoning. The patient is more easily roused in alcohol poisoning. Examine the urine for morphine and alcohol. Get a careful history. **(2)** *From cerebral hæmorrhage.*—If this is in the pons Varolii the pupils may be very contracted and the diagnosis difficult, but look carefully for local paralyses. Usually cerebral hæmorrhage takes place into the internal capsule, and then the face and the limbs on the opposite side are paralysed. If the hæmorrhage is a small one, and especially if it is in the pons, the temperature may be raised; if it is a very large one the temperature falls for the first few hours, but may rise subsequently. If the pupils are unequal the case is one of cerebral hæmorrhage. **(3)** *From carbolic acid poisoning,* in which there may be coma and contracted pupils. The acid produces white patches in the mouth, and the odour is characteristic. **(4)** *From chloroform and ether poisoning* by the odour of the breath and of the vomited matters. **(5)** *From uræmia* by the signs of Bright's disease, especially albuminuria. **(6)** *From diabetic coma* by the smell of the breath and the glycosuria. **(7)** *From the comatose stage of an epileptic fit* by the history, the dilatation of the pupils, and the fact that the lividity does not deepen. **(8)** *From the same stage of a fit in general paralysis* of the insane and other nervous diseases by the same symptoms.

Post mortem.—The appearances after death from opium poisoning are those always found after fatal asphyxia.

Treatment.—Wash out the stomach. Give prompt emetics (p. 129), as apomorphine subcutaneously. Always rouse the patient by walking him about, flapping him with a towel, pinching him, applying the faradic current, and putting ammonia to the nose ; a pint of strong coffee should be injected into the rectum, $\frac{1}{20}$ gr. atropine sulphate given subcutaneously, or 30 ♏ of tincture of belladonna by the mouth repeated every quarter of an hour. If the breathing is very difficult, artificial respiration should be employed. Amyl nitrite inhalations may be used. The treatment must be kept up for several hours if necessary.

Potassium permanganate (equal in amount to the morphine swallowed) dissolved in water may be given. It is a chemical antidote, decomposing the morphine.

Chronic Morphine poisoning.—As many persons administer the drug subcutaneously to themselves, chronic poisoning is very common. The symptoms are that the patient loses all sense of right and wrong, he will lie and thieve in the most degrading way, especially if his desire is to obtain the drug, and absolutely no statement that he makes can be trusted. He neglects his work, and lets his business go to ruin. He wastes and becomes anæmic, he suffers from loss of appetite, indigestion, dry mouth, sluggish bowels, and a foul tongue. The nails are brittle, the skin dry, the hair turns grey early, and falls out. There is sexual impotence, no erections take place, no semen is secreted, there is amenorrhœa, and the flow of milk is stopped, but there is polyuria. The pupils are small, there is loss of muscular power, slight ataxy and tremor in severe cases. The arm is scarred with marks of the syringe, and 20 grains of morphine a day may be taken.

The patient must be isolated and carefully watched to see that he gets no morphine (he often eludes or bribes his nurse) ; it should be diminished gradually, so that at the end of a fortnight he is taking none. If it is stopped suddenly there may be serious collapse and wild delirium. Relapses are very common, and a complete cure after a relapse is very rare.

ANTAGONISM.

Atropine.—Atropine (alkaloid of belladonna) is a valuable antidote to morphine, because it powerfully stimulates the respiratory centre. It also stimulates the cerebral convolutions and intestinal peristalsis, both depressed by morphine.

It appears to be antagonistic to opium in other particulars, but is not really so. Thus, although it prevents perspiration and dilates the pupil, these effects are due to action on the peripheral nerve terminations, while morphine produces contrary results by acting on the central nervous system. Still it has been found that some of the undesirable effects that may follow the subcutaneous injection of morphine, such as indigestion, constipation, and cardiac depression, may be avoided if $\frac{1}{150}$ to $\frac{1}{100}$ gr. of atropine sulphate is injected at the same time.

Codeina.—Codeine. $C_{17}H_{18}(CH_3)NO_3,H_2O$.

SOURCE.—An alkaloid obtained from opium or morphine.

CHARACTERS.—Nearly colourless trimetric crystals. *Solubility.*—1 in 80 of cold water, 1 in 24 of boiling water, 1 in 2 of alcohol (90 per cent.), 1 in 2 of chloroform.

Dose, $\frac{1}{4}$ to 2 gr.

Codeinæ Phosphas. — Codeine Phosphate. $(C_{17}H_{18}(CH_3)NO_3,H_3PO_4)_2,3H_2O$.

CHARACTERS.—White crystals, slightly bitter. *Solubility.*—1 in 4 water.

Dose, $\frac{1}{4}$ to 2 gr.

Preparation.

Syrupus Codeinæ. *Strength.*—$\frac{1}{4}$ gr. of codeine phosphate in each fluid drachm.

Dose, $\frac{1}{2}$ to 2 fl. dr.

ACTION AND THERAPEUTICS.

It may produce tremors because it excites the cord more, and depresses the higher faculties less, than morphine. It often relieves the hacking cough of phthisis, and for this the official syrup of the phosphate is very useful. It is also used for cases of ovarian pain, and to diminish the glycosuria in diabetes; but it is doubtful whether it does this more effectually than opium. For diabetes it is usually given as a pill. The phosphate has the advantage of being much more soluble than codeine.

Thebaine (not official) produces powerful convulsions as a result of its action on the cord.

Anarcotine (not official). This is also known as Narcotine, which is a bad name, for the drug does not cause sleep. It is of use in ague, and it is the chief constituent of Indian opium.

Apomorphinæ Hydrochloridum.—Apomorphine Hydrochloride. $C_{17}H_{17}NO_2,HCl$. It is the same as the Hydrochlorate of Apomorphine, B. P. 1885.

SOURCE.—It is the hydrochloride of an alkaloid obtained by heating morphine hydrochloride or codeine hydrochloride in sealed tubes with hydrochloric acid. The morphine loses one molecule of water, thus: $C_{17}H_{19}NO_3 = C_{17}H_{17}NO_2 + H_2O$.

CHARACTERS.—Small greyish-white, shining needles, turning green on exposure to light and air; faintly acid. *Solubility.*—1 in 50 of water, 1 in 30 of alcohol (90 per cent.).

Dose, $\frac{1}{20}$ to $\frac{1}{10}$ gr. hypodermically, $\frac{1}{10}$ **to** $\frac{1}{4}$ **gr.** by the mouth.

Preparation.

Injectio Apomorphinæ Hypodermica. — Apomorphine Hydrochloride, 1 gr.; diluted hydrochloric acid, 1 ♏; distilled water, 110 ♏. *Strength.*—1 per cent. or 1 gr. in 110 ♏. Must be freshly prepared, as it does not keep.

Dose, 5 to 10 m. hypodermically.

ACTION.

External.—None.

Internal.—*Gastro-intestinal tract.*—Apomorphine is the most powerful **emetic** we possess. It does not act locally on the stomach, but solely on the vomiting centre in the medulla. It is, therefore, an indirect emetic. This is shown by the fact that when the drug is injected subcutaneously it produces violent vomiting if the vessels are so tied that none can reach the stomach, but not if they are so tied that it cannot reach the medulla.

Circulation.— Therapeutic doses have no effect beyond the depressing action which may be attributed to the vomiting. Large doses cause a rise in the rate of the pulse, probably from stimulation of the accelerator nerves, and with fatal doses the pulse-rate falls, because the drug directly paralyses the cardiac muscle.

Respiration.—This is at first stimulated by the act of vomiting. The effect of poisonous doses is doubtful; probably they depress respiration. If the bronchial secretion is thick and viscid it is rendered more fluid by apomorphine.

Nervous system.—The first result of toxic doses is to cause delirium. Finally there is paralysis of the motor nerves, and consequently of the muscles.

THERAPEUTICS.

Vomiting action.—The advantages of apomorphine over other emetics are that it is certain, prompt, and powerful; it can be given when emetics introduced directly into the stomach would not act, and it does not irritate the stomach. It is largely used in cases of poisoning. It is usually given hypodermically. As the pharmacopœial injection will not keep, it is advisable to use gelatin discs of apomorphine hydrochloride, which can be dissolved as required.

Expectorant action.—It is, when given by the mouth, a valuable expectorant for chronic bronchitis when we wish to diminish the viscidity of the expectoration.

The Brit. Pharm. Conference recommends the following syrup of apomorphine (the drug is much less liable to change if dissolved in syrup instead of water):—Mix 7 fl. dr. of each of alcohol (90 per cent.) and water, dissolve in this 5 gr. of apomorphine hydrochloride, add 2 fl. dr. of dilute hydrochloric acid, and then add 18 fl. oz. of syrup. Dose, $\frac{1}{2}$ to 1 fl. dr. Strength $\frac{1}{32}$ gr. of apomorphine hydrochloride in 1 fl. dr. The drug may also be given as a lozenge.

RED POPPY PETALS.

Rhœados Petala.—Red Poppy Petals. The fresh petals of *Papaver Rhœas* (Nat. Ord. *Papaveraceæ*).

CHARACTERS.—Scarlet, with a smell of opium and a bitter taste.

COMPOSITION.—Red colouring matter, 40 per cent. This consists of papaveric and rhœadic acids. It is soluble in water. The petals contain no morphine, nor have they any narcotic properties.

Preparations.

Syrupus Rhœados.—Petals, 13 oz.; sugar, 36 oz.; alcohol (90 per cent.), 2½ fl. oz.; water to make 58 oz. In hot countries the proportion of alcohol may be a little increased to prevent fermentation.

Dose, ½ to 1 fl. dr.

ACTION AND USES.

Poppy petals are only used as a colouring agent.

HOPS.

Lupulus.—Hops. The dried strobiles of *Humulus lupulus* (Nat. Ord. *Cannabineæ*). Obtained from cultivated plants.

CHARACTERS.—Strobiles 1¼ in. long, rounded, consisting of many imbricated greenish-yellow membranous stipules and bracts attached to a zigzag axis.

COMPOSITION.—The chief constituents are—(1) Lupulin, a liquid alkaloid. (2) Lupulinic acid, 11 per cent., a bitter crystalline principle. (3) Valerol, 1 per cent., an aromatic volatile oil giving the odour. (4) Resin. (5) Tannin. (6) A sesquiterpene, $C_{15}H_{24}$.

Preparations.

1. **Infusum Lupuli.**—1 in 20 of boiling water.
Dose, 1 to 2 fl. oz.

2. **Tinctura Lupuli.**—Hops, 1; alcohol (60 per cent.), 5. Macerate.
Dose, ½ to 1 fl. dr.

Lupulinum.—Lupulin. The glands obtained from the strobiles of *Humulus lupulus*.

CHARACTERS.—A granular, bright, bitter, brownish-yellow powder, smelling of hops, which when magnified is seen to consist of minute glands, the cuticle of which is raised by secreted oil.

Dose, 2 to 5 gr.

ACTION.

The volatile oil is **stomachic** and **carminative** like other volatile oils. The bitter principle aids the stomachic influence. Hops are decidedly **soporific.** Probably it is the volatile oil that produces this effect.

THERAPEUTICS.

The pharmacopœial preparations of hop are not much used, but good beer, because of the hops contained in it, is often given with meals to those whose digestion is feeble after a long illness, or from any other cause. Many people find the soporific influence of beer very well marked.

BELLADONNA.

Belladonnæ Folia.—Belladonna Leaves. The fresh leaves, with the branches to which they are attached collected when the plant is in flower, of *Atropa belladonna*. *Synonym.*—Deadly nightshade (Nat. Ord. *Solanaceæ*).

CHARACTERS.—Leaves alternate below, in pairs of unequal size above, all shortly stalked, from 3 to 8 in. long, broadly ovate, acute, entire, smooth. The expressed juice or an infusion, dropped into the eye, dilates the pupil. *Resembling belladonna leaves.*—Stramonium leaves, more wrinkled; hyoscyamus leaves, hairy.

COMPOSITION.—The chief constituents are—(1) *Atropine* (q. v.), 0·06 to 0·3 per cent. (2) *Hyoscyamine*, another alkaloid, chemically closely allied to and having a very similar action to atropine. It, hyoscine (*see* pp. 344, 345), daturine (*see* p. 342), duboisine, and scopalamine, all derived from atropaceous plants, are nearly *identical*, and exist as malates in the plant. It has been stated that atropine does not exist in belladonna in the natural state, but that it is a conversion product of hyoscyamine, which is the natural alkaloid of belladonna.

Preparations.

1. **Extractum Belladonnæ Viride.**—A green extract.

Dose, $\frac{1}{4}$ to 1 gr.

2. **Succus Belladonnæ.**—Juice, 3; alcohol (90 per cent.), 1.

Dose, 5 to 15 m.

Belladonnæ Radix.—Belladonna Root. The root of *Atropa belladonna*, collected in the autumn and dried.

CHARACTERS.—Cylindrical branched pieces entire or longitudinally split, 6 to 12 in. long, $\frac{3}{8}$ to $\frac{3}{4}$ in. thick. Externally pale greyish brown, wrinkled longitudinally. Fracture short. Internally the root is white and starchy, with no very evident radiate appearance. *Resembling belladonna root.*—Pyrethrum root, which is unbranched, and has a burning taste and a radiate fractured surface. Scammony root is larger.

COMPOSITION.—As of the leaves. Usually contains 0·4 to 0·5 per cent. of alkaloids, chiefly atropine.

Preparations.

1. Extractum Belladonnæ Liquidum.—Prepared by repeated percolation with alcohol and water. *Standardized to contain* 0·75 *per cent. of the alkaloids of the root.*

2. Extractum Belladonnæ Alcoholicum.—The liquid extract evaporated and diluted with sugar of milk. *Strength.*—1·0 per cent. of alkaloids. It is about $\frac{1}{3}$ of the strength of same preparation, B. P. 1885.
Dose, $\frac{1}{4}$ to 1 gr.

3. Emplastrum Belladonnæ.—Liquid extract, 4; evaporate and add resin plaster, 5. *Strength.*—0·5 per cent. of the alkaloids.

4. Linimentum Belladonnæ.—Liquid extract, 10 fl. oz.; alcohol (90 per cent.), 7 fl. oz.; camphor, 1 oz.; water, 2 fl. oz. *Strength.*—0·37 per cent. of alkaloids.

5. Tinctura Belladonnæ. — Liquid extract, 2 fl. oz.; alcohol (60 per cent.). Mix to make 30 fl. oz. *Standardized to contain* 0·05 *per cent. of total alkaloids of the root.* It is about twice as strong as in B. P. 1885.
Dose, 5 to 15 m.

6. Unguentum Belladonnæ.—Liquid extract, 2, evaporate and add benzoated lard, $2\frac{1}{4}$. *Strength.*—0·6 per cent. of alkaloids.

7. Suppositoria Belladonnæ.—Alcoholic extract, $1\frac{1}{2}$ gr.; oil of theobroma, 14 gr. *Strength.*—Each contains $\frac{1}{60}$ gr. of the alkaloids.

Atropina.—Atropine. *Synonym.*—Atropia. $C_{17}H_{23}NO_3$.

SOURCE.—An alkaloid obtained from the leaves and root of the belladonna plant. It exists there as malate of atropine. (*See* p. 330.)

CHARACTERS.—Colourless acicular crystals. *Solubility.*—1 in 300 of cold, 1 in 58 of boiling water, 1 in 1 of chloroform, 1 in 3 of alcohol (90 per cent.), 1 in 30 of ether, 1 in 52 of glycerin, and 1 in 15 of oleic acid. It can be decomposed into tropine and tropic acid, and reconstructed by their synthesis. It is distinguished from hyoscyamine by its melting point, optical properties, and molecular constitution.

INCOMPATIBLES.—Caustic alkalies decompose it.

Dose, $\frac{1}{200}$ to $\frac{1}{100}$ gr.

Preparation.

Unguentum Atropinæ.—Atropine, 10; oleic acid, 40; lard, 450.

Atropinæ Sulphas.—Atropine Sulphate. $(C_{17}H_{23}NO_3)_2H_2SO_4$.

SOURCE.—It may be obtained by neutralizing atropine with diluted sulphuric acid.

CHARACTERS.—Nearly colourless, crystalline substance. *Solubility.*—1 in 1 of water, solution neutral, 1 in 10 of alcohol (90 per cent.).

Dose, $\frac{1}{200}$ to $\frac{1}{100}$ gr.

Preparations.

1. **Lamellæ Atropinæ.**—Discs containing in each, atropine sulphate, $\frac{1}{5000}$ gr.; gelatin and glycerin, $\frac{1}{50}$ gr.

2. **Liquor Atropinæ Sulphatis.**—Atropine sulphate, 17½ gr.; salicylic acid, 2 gr.; distilled water, 4 fl. oz. *Strength.*—1 per cent. or 1 gr. of the sulphate in 110 ♏.

Dose, ½ to 1 m.

ACTION.

The action of belladonna and atropine is the same.

External.—Atropine placed by itself upon the unbroken skin cannot be absorbed, but rubbed in with substances which are absorbed, such as alcohol, glycerin, camphor, &c., or applied to a broken surface, it paralyses the terminations of the sensory nerves, especially if pain is present. It is thus a **local anæsthetic** and an **anodyne.** These are its chief actions; but to a much less extent it locally paralyses the terminations of the motor nerves, first contracts and then dilates the vessels, and renders the secretions of the skin less active.

Internal.—*Gastro-intestinal tract.*—It will be convenient to describe the effects of belladonna on all secretions when speaking of its action on nerves, and we need not mention here its influence on the muscular coat of the intestine, for that is secondary to its action on the nervous system.

Blood.—Atropine is quickly absorbed, but does not affect the blood. Its main action is on the nervous system, and that must be considered in detail.

Secretory nerves.—The activity of the **peripheral terminations of all the secretory nerves** in the body is, as far as we know, **depressed.** These nerves fall under the following headings.

(*a*) *Mouth.*—Even small doses of atropine make the **mouth dry** from lack of saliva and mucus. In health secretion of submaxillary saliva always follows stimulation of the chorda tympani nerve, and, as is well known, this is due to the fact that this nerve is the secretory nerve for this gland, and not to any vascular dilatation. If atropine be given to an animal, stimulation of the chorda no longer causes an increased flow of saliva, however close to the gland the nerve is excited, the reason being that atropine has paralysed the terminations of the chorda tympani. In the same way the terminations of the secretory nerves of the other salivary glands and the mucous glands are paralysed, and hence the mouth is dry, because normal impulses cannot reach the cells of the glands.

Stomach, liver, and intestines.—We do not know what influence atropine has on the secretions of these organs.

Sweat glands.—Atropine paralyses the terminations of the nerves in the sudoriparous glands. Thus it causes the **skin** to become **dry.**

Kidneys.—The effect of atropine on the amount of urine secreted is necessarily uncertain, as the urinary flow depends so much on the secretion of sweat.

Bronchial mucous membrane.—The secretion of

bronchial and **tracheal mucus**, like that of the mouth, is **diminished.**

Mammary gland.—The activity of the peripheral terminations of the secretory nerves in the cells of the mammary gland is inhibited; hence the flow of **milk**, if any is present, is **arrested**, and belladonna is called an antigalactogogue.

Sensory nerves.—It has already been mentioned that belladonna rubbed into the skin depresses the function of the terminations of the sensory nerves. It does the same when given by the mouth, but its action on sensory nerves—that is to say, its anæsthetic and anodyne action—is very inferior to that on the secretory nerves, and is not powerful enough for atropine to relieve pain when given internally. It is only used as a local anodyne.

Voluntary muscles and their nerves.—Voluntary muscles are quite unaffected even by toxic doses of atropine; towards the end of a case of belladonna poisoning the motor nerves are slightly paralysed.

Involuntary muscles and their nerves.—The splanchnics are the inhibitory nerves of the intestinal movements, and if they are stimulated the peristaltic movements stop; impulses are constantly descending these nerves to restrain these movements. If atropine in small doses is given to animals, it is observed that the bowels are relaxed, because intestinal **peristalsis** is much **increased**, and that stimulation of the splanchnics is powerless to arrest it; clearly the drug has paralysed the terminations of the splanchnics in the involuntary muscles of the intestine. Larger doses stop peristalsis.

Probably the nerve terminations in the muscles of the bladder, ureters, urethra, vesiculæ seminales, uterus, and vagina are affected in the same way as those in the intestinal muscles, but this is not yet decided.

The eye and its nerves.—Atropine acts only on the terminations of the nerves in the involuntary muscles of the eye. If it be dropped into the eye or given by the mouth, the **pupil dilates widely,** and cannot be made to contract by stimulation of the third nerve. That this dilatation is not due to any action on the muscular fibres of the iris themselves is shown by the fact that the atropinized pupil will contract if the muscle itself be stimulated. Therefore it must be that the **terminations of the third nerve** in the iris **are paralysed.** The ending of this nerve in the ciliary muscle is affected in the same way, and consequently **accommodation is paralysed.** It is certain that this mydriasis and defective accommodation is in no part central, as is the contraction of the pupil produced by opium. So strong is the local action of belladonna, that if atropine be dropped into the recently excised eye the pupil will dilate. When the third nerve is cut the pupil dilates, and if after this atropine be dropped into the eye it dilates still further. Some have concluded, from this and other reasons, that atropine also stimulates the terminations of the sympathetic in the iris; but the reasoning is inconclusive, and it is not at present proved that atropine can do this. The intra-ocular tension is increased by large doses. There is, as a result of the paralysis of the ciliary muscle, disturbance of vision. Atropine does not act on the pupils of birds.

The heart and its nerves.—The main action of atropine is **to paralyse the terminations of the vagus** in the heart, and consequently the **pulse is rendered more rapid,** and cannot be slowed by strongly stimulating the vagus. If the rate of the heart has been lowered by muscarin, which can be shown to have a local stimulating influence on the terminations of the vagus in the heart, the application of atropine renders the heart quick again, the two drugs being, in their effect on the heart, exactly antagonistic. This quickening of the pulse from inhibition of the vagal cardiac terminal filaments is the chief action of atropine on the heart, but the following minor actions must be noticed. The vagus centre and the trunk of the nerve are also depressed, but to a much less extent. Before the pulse is quickened it is occasionally slowed for a short time by atropine; this is probably owing to a brief excitation of the vagus centre, the vagus nerve, and its peripheral cardiac terminations. Some authorities believe that part of the quickening of the pulse is due to a slight stimulation of the cardiac accelerator nerves, just as we have seen that some consider that the sympathetic fibres in the iris are excited; but if the accelerator nerves are stimulated, this stimulation is quite subsidiary to the important paralysis of the vagal terminations. Although the **pulse** is quickened by belladonna, its **force is not diminished.** Toxic doses abolish the function of the cardiac muscle, and the heart stops in diastole.

Vaso-motor system and its nerves.—After a considerable dose of belladonna the **skin is flushed**, and a scarlatiniform erythematous rash may be present in belladonna poisoning. It is thus obvious that such a dose of belladonna relaxes the peripheral vessels. The exact cause of this has not definitely been made out, but it is extremely probable that it is largely a peripheral action, quite harmonizing with the peripheral action we have seen atropine to have on the involuntary muscles of the intestines, eye, and heart; that is to say, the vaso-constrictor nerve-filaments supplying the arterioles are paralysed, and consequently the vessels dilate. The action of atropine on the medullary vaso-motor centre is more marked than that on the cardiac medullary centre; but it is the same—the centre first being stimulated, and then depressed. This primary stimulation is sufficient to overcome the tendency of the peripheral vessels to dilate, so that belladonna at first contracts them; and as this stage of contraction lasts well into the period during which, owing to paralysis of the vagal terminations, the heart is accelerated, the **blood-pressure rises** considerably; **subsequently it falls**, the fall being due to the depression of the vaso-motor centre and the peripheral action of belladonna on the vessels, causing their wide dilatation. Ultimately, when the heart itself is paralysed, the blood-pressure is very low. The spinal vaso-motor centres are acted on as powerfully and in the same way as the medullary centre.

Respiration and its nerves.—Here also belladonna **paralyses peripheral nerve-filaments**, in this case those of the vagus in the bronchial tubes. Both the afferent and efferent pulmonary vagal fibres are affected. The result is that the **muscular coat** of the bronchial tubes is **relaxed**, and that the secretions (the activity of the afferent fibres being depressed) do not irritate the nerves so much as before, and therefore cough is lessened. It will be remembered that the quantity of bronchial secretion is diminished. The medullary and spinal respiratory centres are influenced precisely as the vaso-motor—that is to say, they are first stimulated, and so the respirations are quicker and deeper, then large doses paralyse them, and the breathing is slow and shallow. The patient becomes asphyxiated, and this contributes to the result in a fatal case.

Temperature.—This is decidely **raised** by toxic doses of belladonna (it may be four degrees or more). This rise is independent of the blood-pressure and of the diminution of perspiration. It is said that heat-production is greatly exaggerated. The heat-loss is also increased, probably because the flushing of the skin leads to a greater loss by radiation.

Spinal cord.—Except for the action on the vaso-motor and respiratory spinal centres, belladonna has little influence on the spinal cord in man, but it has a well-marked tetanizing effect in frogs. It is said slightly to increase and afterwards diminish general reflex excitability.

Cerebrum.—A considerable dose of belladonna causes **delirium**, showing that the higher centres are stimulated. Generally the stimulation takes place incoordinately. That it is powerful is indicated by the fact that in poisoning by belladonna the delirium will last for a long while. The subsequent quietude is not more than the exhaustion of the cerebrum from the continued delirium will explain. Belladonna rarely, if ever, produces genuine coma. Other symptoms that may be observed with large doses, and which are probably due to disorder of the brain, are staggering gait, giddiness, and occasionally convulsions.

Elimination.—Atropine is probably eliminated entirely by the kidney.

It will be seen that the **dominant action** of belladonna is to **depress** the activity of the terminations of nearly **all varieties of nerves.** In addition, it **first stimulates** and **then depresses** the **three great medullary centres,** and it is a deliriant. A summary of its effects on man will be given under the heading of Toxicology.

Children can take considerable doses of belladonna without any symptoms of poisoning.

Pigeons and rodents are peculiarly insusceptible to it.

THERAPEUTICS.

External.—Belladonna is used externally to relieve all sorts of pain—for example, that of neuralgia, pleurodynia, and chronic osteo-arthritis. The liniment is excellent for these purposes. A glycerin preparation made by rubbing green extract of belladonna 1 oz. with boiling water 2 fl. dr., and then adding gradually glycerin 3 fl. oz., soothes the pain of acute inflammations. This, or the plaster, or the ointment, is very efficacious in preventing the secretion of milk in women who do not for any reason nurse their infants. Pruritus and local sweating of various parts of the body, especially the feet, may sometimes be stopped by the frequent application of belladonna liniment. A lamella, or a solution of the same strength (atropine sulphate 4 gr., camphor water 1 fl. oz.), will dilate the pupil for ophthalmoscopic examination. Atropine is often used in ophthalmic practice to paralyse the movements of the iris and ciliary muscle, to break down adhesions, and to prevent the formation of contractions of the iris (*see* Homatropine, p. 341).

Internal.—*Alimentary canal.*—Atropine has occasionally been employed to check salivation, and some use it to overcome constipation and colic. The alcoholic extract is then given, and is commonly combined with some purgative in a pill. Alcoholic extract of belladonna may be administered with opium in the form of a pill to patients suffering from appendicitis or peritonitis; as it is given several times a day, a large amount is taken, and this, as already explained, probably paralyses intestinal movements, and so aids the opium.

Skin.—Atropine sulphate ($\frac{1}{100}$ gr.) injected subcutaneously, or one or two minims of the Liquor Atropinæ Sulphatis by the mouth, will sometimes arrest sweating, and this treatment may succeed with the night sweats of phthisis.

Circulation.—There are many cases of heart disease in which belladonna may advantageously be combined with other drugs. Whenever we wish to empty the ventricle completely it is useful, for it will be remembered that it increases the rapidity of the heart without diminishing the force. But its greatest value is to remove cardiac pain and distress, which it often does most effectually. It may be conveniently applied as a plaster over the cardiac region, or it may be given internally, usually as the tincture.

Respiration.—As belladonna relaxes the muscular coat of the bronchial tubes it is of great value in spasmodic affections of the respiratory passages. Thus, of all the numerous drugs that have been given for whooping-cough, it is the best. It is also very useful in asthma, and in bronchitis with asthma-like paroxysms; in the last-named disease its powerful stimulation of the respiratory centre and its capability of diminishing the secretion will, in properly chosen cases, render it particularly valuable. It is generally given as the tincture, and combined with other drugs.

Genito-urinary diseases.—Belladonna is one of the favourite remedies for the nocturnal incontinence of children, and it occasionally overcomes this trouble in adults when it is not due to organic disease. Its power of relieving the spasm of involuntary muscle is well shown in the effectual manner in which the very painful vesical spasm which accompanies calculus, cystitis, and prostatitis may be benefited by it. It may be given internally, or applied as a plaster to the perinæum.

It has been tried in many nervous diseases, but without any good results.

TOXICOLOGY.

If a person takes a moderate dose of belladonna he soon experiences dryness of the mouth and throat, and as the food, therefore, cannot be properly lubricated, there is difficulty of swallowing; the pulse may at first be a little slower than usual. The pupil is dilated; accommodation is defective, and vision confused. The skin feels dry. If the dose has been a large one, these symptoms all come on quickly; the conjunctivæ and face, and perhaps other parts of the skin, are flushed, and the rate of the pulse is greatly increased, it may even be doubled. The patient staggers, feels giddy, and reels when he walks; the throat soon becomes very hot, the skin still more flushed, the eyelids swell, and there may be a uniform erythematous rash.

The temperature is often raised, the respirations are slow and deep. The pupils are very widely dilated. By this time the patient is quite delirious. There may be purging, but this is not common; and sometimes he complains of a frequent desire to micturate, although he is unable to pass any urine. Death takes place from cardiac failure combined with asphyxia. *Post mortem.*—The organs are all in a state of venous congestion, which is due to the asphyxia. If recovery takes place the patient may have no recollection of his illness.

Treatment.—Give emetics (p. 129) or wash out the stomach. Inject pilocarpine and stimulants subcutaneously. Employ artificial respiration.

ANTAGONISM.

The antagonism between atropine and morphine has already been discussed (*see* p. 325). It is clear that as *pilocarpine* stimulates the terminations of the secretory nerves in the salivary and sweat glands, and also excites the terminations of the third nerve in the iris and ciliary muscle, it is a diaphoretic, a sialogogue, and a myotic, and is in these respects antagonistic to atropine. *Physostigmine* also causes contraction of the pupil and spasm of the ciliary muscle by stimulation of the terminations of the third nerve, and it depresses the respiratory centre almost from the beginning. In these points it is an antagonist to atropine.

Homatropinæ Hydrobromidum.—Homatropine Hydrobromide. $C_{16}H_{21}NO_3HBr$.

The hydrobromide was called the hydrobromate in the B. P. 1885 (Addendum, 1890).

SOURCE.—It is the hydrobromide of an alkaloid prepared from tropine.

CHARACTERS.—A white crystalline powder or aggregation of minute trimetric crystals. *Solubility.*—1 in 6 of water, 1 in 133 of absolute alcohol.

Dose, $\frac{1}{80}$ to $\frac{1}{20}$ gr.

Preparation.

Lamellæ Homatropinæ.—Discs of gelatin and glycerin each weighing $\frac{1}{50}$ gr. and containing $\frac{1}{100}$ gr. of homatropine hydrobromide.

ACTION AND THERAPEUTICS.

Homatropine has an action exactly similar, as far as we know, to that of atropine. It is only used to dilate the pupil in ophthalmic practice, the advantage over atropine being that the dilatation produced by homatropine passes off in a quarter of the time. It may be applied either as a solution (4 gr. of the hydrobromide to 1 fl. oz. of distilled water) or as the lamella. Sometimes a solution in castor oil is used, for it is less likely to be washed out by the tears, but it may be rather irritating.

STRAMONIUM.

Stramonii Semina.—Stramonium Seeds. The dried ripe seeds of *Datura stramonium*, the thorn-apple (Nat. Ord. *Solanaceæ*).

CHARACTERS.—One-sixth inch long, reniform, flattened, brownish black, finely pitted, wrinkled. Taste bitter.

COMPOSITION.—The chief constituent is *daturine* (0·02–0·03 per cent.), an alkaloid in crystals resembling atropine, but lighter and more feathery. It exists as a malate. It is certainly very closely allied to hyoscyamine, and some consider that the two are identical (*see* p. 345). Some specimens are said to consist of atropine and hyoscyamine mixed.

INCOMPATIBLES.—Caustic alkalies, metallic salts, and mineral acids.

Preparation.

Extractum Stramonii.—Alcoholic.
Dose, $\frac{1}{4}$ to 1 gr.

Stramonii Folia.—The dried leaves of *Datura stramonium.* Collected from plants in flower.

CHARACTERS.—Ovate, petiolate, 4–6 in. long, dark green, wrinkled, unequal at base, margin sinuate-dentate, and apex acuminate. Odour slightly narcotic. Taste saline and bitter. *Resembling stramonium leaves.*—Belladonna leaves, less wrinkled; hyoscyamus leaves, hairy.

COMPOSITION.—As of the seeds, but the proportion of daturine is very inconstant.

Preparation.

Tinctura Stramonii.—Stramonium leaves, 1; alcohol (45 per cent.), 5. Percolate.
Dose, 5 to 15 m.

ACTION.

The physiological action of daturine is precisely that of atropine, and therefore that of stramonium is almost the same as that of belladonna; the differences being that stramonium relaxes the muscular coat of the bronchial tubes more powerfully than belladonna, and it may cause the heart to be a little irregular.

Daturine is generally thought to be more active than atropine.

THERAPEUTICS.

There is no reason why stramonium should not be employed for the same purposes as belladonna, but it is rarely used, except in cases of asthma to relieve the spasm of the bronchial tubes. For this it is very valuable. Cigarettes of the leaves may be smoked, or the drug may be given internally. The following powder, which gives off dense fumes if burnt, affords great relief for asthma:—leaves of Datura Stramonium and of Datura Tatula, Cannabis Indica, and Lobelia Inflata, all in powder, and of each 6 dr.; nitre in powder, 1 oz.; eucalyptus oil, 30 ♏. Mix thoroughly. Himrod's, Bliss's, and other "cures" for asthma are of a similar composition.

HENBANE.

Hyoscyami Folia.—Hyoscyamus Leaves. *Synonym.*—Henbane Leaves. The fresh leaves and flowers, with the branches to which they are attached, of *Hyoscyamus niger* (Nat. Ord. *Solanaceæ*); also the leaves separated and flowering tops from the branches, carefully dried. Collected from flowering biennial plants.

CHARACTERS.—Varying in length up to 10 in., with or without stalks, alternate, exstipulate, triangular-ovate or ovate-oblong, pale green, glandular-hairy, particularly underneath. Branches subcylindrical, and also glandular-hairy. Odour strong, heavy when fresh. Taste bitter, slightly acrid. The juice dropped in the eye dilates the pupil.

Composition.—The chief constituents are—(1) *Hyoscyamine*, $C_{17}H_{23}NO_3$, an alkaloid. Characters: snow-white masses of minute crystals. *Solubility.*—1 in 120 of water, freely in spirit. It is very closely allied to the active alkaloids of belladonna and stramonium (*see* p. 330). It is also contained in many plants of the Natural Order *Solanaceæ*. It, like atropine, consists of tropic acid and tropine. There is in commerce an amorphous impure hyoscyamine, which is a dark brown extract-like fluid having a disagreeable odour. As it is much cheaper than the crystalline alkaloid it is often used. Probably it contains no hyoscyamine, but only hyoscine. (2) *Hyoscine.* $C_{17}H_{21}NO_4H_2O$. Characters: a white crystalline alkaloid. It is stated to be the same as scopolamine, an alkaloid isomeric with cocaine. It is the active constituent of commercial hyoscyamine. Only its salts are used.

Incompatibles.—Vegetable acids, silver nitrate, lead acetate, alkalies.

Preparations.

1. **Extractum Hyoscyami Viride.**—A green extract from the fresh plant.
Dose, 2 to 8 gr.

2. **Pilula Colocynthidis et Hyoscyami.**—Green extract of hyoscyamus, 1; compound pill of colocynth, 3 (*see* Colocynth, p. 449).
Dose, 4 to 8 gr.

3. **Succus Hyoscyami.**—Fresh juice, 3; alcohol (90 per cent.), 1.
Dose, ½ to 1 fl. dr.

4. **Tinctura Hyoscyami.**—*Dried* leaves, 1; alcohol (45 per cent.), 10. Percolate.
Dose, ½ to 1 fl. dr.

Hyoscinæ Hydrobromidum.—Hyoscine hydrobromide, $C_{17}H_{21}NO_4,HBr,3H_2O$. *Synonym.*—Scopolamine hydrobromide. The hydrobromide of an alkaloid contained in Hyoscyamus leaves, different species of Scopola, and possibly other solanaceous plants.

Characters.—Colourless, transparent, rhombic crystals, slightly bitter taste. *Solubility*—1 in 1 cold water; 1 in 13 alcohol (90 per cent.).

Dose, $\frac{1}{200}$ to $\frac{1}{100}$ gr.

Hyoscyaminæ Sulphas. — Hyoscyamine Sulphate $(C_{17}H_{23}NO_3)_2H_2SO_4,2H_2O$. The sulphate of an alkaloid contained in Hyoscyamus leaves, and possibly other solanaceous plants.

CHARACTERS.—A crystalline, deliquescent, odourless, bitter powder. *Solubility.*—2 in 1 water; 1 in 2½ alcohol (90 per cent.).

Dose, $\frac{1}{200}$ to $\frac{1}{100}$ gr.

Both hyoscine and hyoscyamine salts are usually given subcutaneously. Convenient discs of both of them, to be dissolved before use, are prepared.

ACTION.

The action of hyoscyamus is almost identical with that of belladonna and stramonium, because of the identity of the hyoscyamine in hyoscyamus, the atropine in belladonna, and the daturine in stramonium. The following are the chief points of difference. (1) Hyoscyamus contains in addition **hyoscine** in minute quantities. This is a powerful **cerebral** and **spinal sedative,** and therefore the excitation and delirium occasioned by the atropine in belladonna are not so evident when hyoscyamus is given; indeed, that may, owing to the hyoscine in it, distinctly depress the higher functions of the brain. The heart is not quite so powerfully affected by hyoscyamus as by belladonna, for hyoscine has a comparatively feeble cardiac influence. Still it is, of course, affected by the hyoscyamine, which acts like atropine. (2) **Hyoscyamus increases the peristaltic contractions** of the intestines more powerfully than belladonna, and at the same time it is more efficient in **relieving the griping** of other purgatives. (3) **Hyoscyamus** has a **more** markedly **sedative** action on the **urinary unstriped muscle** than belladonna.

THERAPEUTICS.

Hyoscyamus might be used for the same purposes as belladonna, but is chiefly employed in combination with purgatives to diminish their griping action. It is also largely given to relieve vesical spasm in calculus, cystitis, and prostatitis, usually in conjunction with other urinary sedatives, as buchu, uva ursi, or benzoic acid if the urine is alkaline. It will be noticed that the doses of the preparations of hyoscyamus are larger than those of the corresponding preparations of belladonna.

Hyoscine and hyoscyamine may, if given cautiously, be employed as cerebral depressants, and are used in acute mania, delirium tremens, febrile delirium, and insomnia, sometimes with good results. They are mostly given in asylum practice. Hyoscine is most used, and is usually given subcutaneously. Chorea, paralysis agitans, and other convulsive diseases have been treated with them, but the convulsions always recur when these drugs are discontinued. They must be given carefully, as the activity of different specimens varies.

Duboisinæ Sulphas.—(Not official.)

The sulphate of the alkaloid duboisine obtained from the leaves of *Duboisia myoporoides.* Duboisine is probably identical with hyoscine (*see* p. 344).

ACTION AND THERAPEUTICS.

The actions of duboisine are like those of atropine, and ophthalmic discs containing $\frac{1}{5000}$ of a grain are used to dilate the pupil.

CANNABIS INDICA.

Cannabis Indica. — Indian Hemp. The dried flowering or fruiting tops of the female plants of *Cannabis sativa* (Nat. Ord. *Cannabineæ*), from which the resin has not been removed. India.

CHARACTERS.—In compressed dusky green masses, consisting of the branched upper part of the stem bearing the remains of flowers, leaves, and a few ripe fruits, and compressed by adhesive resin. The upper leaves are simple, alternate, 1—3 partite; the lower opposite and digitate. The fruit is one-seeded, supported by a bract.

COMPOSITION.—The chief constituents are said to be—(1) Cannabinon, an active principle. (2) Cannabinine, a volatile alkaloid. (3) Tetano-cannabine, an alkaloid. (4) Cannabin, a glucoside. (5) Cannabene, a volatile oil. (6) A resin, said to be very active.

INCOMPATIBLES.—Water, which precipitates the resin.

Preparations.

1. **Extractum Cannabis Indicæ.**—Alcoholic. **Dose, $\frac{1}{4}$ to 1 gr.**

2. **Tinctura Cannabis Indicæ.**—Extract, 1; alcohol (90 per cent.), 20. Simple solution.

Dose, 5 to 15 m.; should be triturated with mucilage before water is added, as this precipitates the very bulky resin.

Tincture of Indian Hemp is contained in Tinctura Chloroformi et Morphinæ Composita.

Synonyms.—Haschisch is a confection of the drug. Gunjah, or ganga, is the dried flowering tops of the cultivated female plants which are coated with resin. Churrus or charas is the resin scraped off the leaves. Bhang is the dried leaves. In some provinces it means powdered ganga made into a drink. Ganga and charas are often smoked like tobacco.

ACTION.

External.—None is known.

Internal.—The effects of cannabis indica vary very much in different people. This is partly due to the uncertain strength of the preparations of the drug, and partly to individual peculiarities, but generally the symptoms are somewhat as follows. After some time, usually from half an hour to two or three hours, there is a pleasurable sensation of mild intoxication; the patient is particularly gay, joyous, and pleased with everything; he will laugh and smile on the slightest provocation, and is himself able to say sharp, witty things. Pleasant ideas flit through his mind with wonderful rapidity, so that time seems to him much extended. Generally the ideas are quickly forgotten, but sometimes the memory of them remains after recovery. The eyes are bright, the pupils may be dilated. The limbs feel heavy, and there is a marked lowering of general sensibility, so that he scarcely feels a severe pinch; this may pass on to complete anæsthesia. There may be headache. After a time sleep, which is often accompanied by delightful dreams, comes on. The drug is frequently taken in the East to produce the early pleasurable symptoms, and, in moderation, it causes no harm. Very few take it to excess, but in them it leads to loss of appetite and strength, trembling, and insanity. Cannabis indica is reputed to occasionally produce sexual excitement, but this is incorrect. Large doses given to a dog only made him sleepy, and uncertain on his legs, but he appeared contented and pleased. Much the same results followed when a monkey was made to inhale the smoke daily for 181 days.

THERAPEUTICS.

It has been given with success in migraine and neuralgia, but it very often fails to afford relief. Its use as an hypnotic has been discarded. The tincture is very difficult to prescribe, because of the voluminous precipitate of resin which falls on the addition of water. Mucilage must be used to suspend it, and the taste should be covered with spirit of chloroform.

CAFFEINE.

Caffeina. — Caffeine. $C_8H_{10}N_4O_2,H_2O$. *Synonyms.*—Theine, Guaranine.

SOURCE.—An alkaloid usually obtained from the dried leaves of *Camellia thea*, common tea (Nat. Ord. *Ternströmiaceæ*), or the dried seeds of *Coffea arabica*, common coffee (Nat. Ord. *Rubiaceæ*). When evaporated from aqueous solutions it contains one molecule of water.

CHARACTERS.—Colourless, silky, inodorous, acicular crystals. *Solubility.*—1 in 80 of cold water, 1 in 1 of boiling water, 1 in 40 of alcohol (90 per cent.), 1 in 400 of ether, 1 in 7 of chloroform.

The solubility of caffeine is perfect in cold water, if for each grain of caffeine ½ a grain of sodium salicylate is added. The addition of alcohol as in tinctures or spirit of chloroform does not impair the solubility. Tea contains 3 to 5 per cent. (hence the name theine). Coffee, 1·3 per cent. (coffee leaves contain much more). Guarana (the seeds of *Paullinia sorbilis*), 5 per cent. (hence the name guaranine). Maté (Paraguay tea, the leaves of *Ilex paraguayensis*), 1·2 per cent. It also exists in the kola nut (which is used as a beverage in Africa); this is the fruit of *Sterculia acuminata.* Caffeine is trimethyl-xanthine, theobromine is dimethyl-xanthine, and both can be prepared synthetically from xanthine. It is a feeble alkaloid, its salts being very liable to split up.

INCOMPATIBLES.—Potassium iodide, salts of mercury and tannic acid.

Dose, 1 to 5 gr. or more.

Caffeinæ Citras.—Caffeine Citrate. $C_8H_{10}N_4O_2$, $C_6H_8O_7$.

SOURCE.—Add caffeine to a hot solution of citric acid, and evaporate.

CHARACTERS.—A white, inodorous powder. A feeble salt, easily splitting up. Taste and reaction acid. *Solubility.*—1 in 32 of water, 1 in 22 of alcohol (90 per cent.), 1 in 10 of a mixture of 2 of chloroform and 1 of alcohol (90 per cent.). With 1 in 10 of water, it forms a clear, syrupy, supersaturated solution, but directly the mixture is stirred the caffeine citrate is precipitated; then, if more water is added, this precipitate re-dissolves. This peculiarity in the solubility of caffeine citrate often leads to mixtures being prescribed in which the caffeine citrate is precipitated, but then it can be suspended in mucilage. The solubility of caffeine citrate is not aided by sodium salicylate, for that salt turns out the citric acid, and thus precipitates caffeine sodium salicylate in the form of a very bulky precipitate.

INCOMPATIBLES.—The same as of caffeine.

Dose, 2 to 10 gr.

Caffeinæ Citras Effervescens.—Effervescing Caffeine Citrate.

SOURCE.—Mix citric acid, 18 oz., tartaric acid, 27 oz., caffeine citrate, 4 oz. Also mix sodium bicarbonate, 51 oz., refined sugar, 14 oz. Incorporate the two mixtures, heat to 210° F. When the mixture is granular pass through a sieve, and dry at a temperature not exceeding 130° F.

Dose, 60 to 120 gr.

ACTION.

External.—None.

Internal.—*Alimentary canal.*—Excessive tea-drinking may cause indigestion, but this is probably induced by the tannin in the tea, and not by the caffeine. The teeth of tea-tasters are very liable to decay. Coffee is, with some persons, slightly laxative; it is not known to what ingredient this is due.

Circulation.—Caffeine is freely absorbed. It produces no change in the blood. Moderate doses **increase** the **force** of the cardiac **contraction and the duration** of the **systole**, the diastolic period being shortened; as a consequence of this the blood-pressure rises. The rate of the pulse varies. Toxic doses paralyse the heart. These effects are also produced by the local application of caffeine to the heart of the frog.

Respiration.—In animals the rate of breathing is increased by caffeine. Medicinal doses are said to excite and toxic doses to depress it.

Nervous system.—It is well known that tea and coffee **stimulate** the **cerebrum**. This is due to the caffeine in them. The patient becomes wakeful, the mental activity and capability for work are increased, the reasoning powers being quite as much affected as the imagination. In this respect the cerebral stimulation of caffeine differs from that of opium, and also in that the excitation is not incoordinate, nor is it soon replaced by sleep. Very excessive tea-drinking causes trembling of all the muscles of the body, and makes the patient extremely "nervous."

In man tho spinal cord and muscles are very little affected by caffeine, but in some frogs the spinal cord is decidedly stimulated, and convulsions occur; in other species the muscles are thrown into a state of rigidity, which is clearly due to an action on the muscles themselves, for it follows the local application of caffeine to an isolated muscle. Sometimes the muscle curve is altered in character. It is believed that in man the powers of muscular endurance are increased by caffeine. Motor and sensory nerves are uninfluenced in all animals.

Kidneys.—By means of an oncometer it has been shown that the first effect of a dose of caffeine is to cause a contraction of the kidney with a decrease in the urinary flow; but soon the organ becomes larger than it was before the experiment, and the flow of urine is increased. Thus caffeine is a good **local diuretic.**

Metabolism.—Many elaborate experiments have been made upon the action of caffeine on tissue waste, they are all of them inconclusive, probably because it has no effect. Some say it decreases, some that it increases, the elimination of urea. Toxic doses may cause a rise of temperature.

THERAPEUTICS.

Heart.—Caffeine has been most used in heart disease. It is given when, as in aortic or mitral obstruction, a purely stimulant effect is desired; large doses, 3 or 8 grains a day of caffeine, are often easily borne, and may be combined with strychnine. It will not replace digitalis, for it does not slow the heart much nor make it regular, and it shortens the diastole. It is, on account of its diuretic action, especially valuable in cardiac cases in which there is dropsy. Tea and coffee are, in some persons, liable to produce irregularity of the heart.

Kidney.—Small doses of caffeine are powerfully diuretic, and are therefore used in heart disease, ascites, pleuritic effusion, &c. As the drug acts directly on the kidney, it should be given cautiously in renal disease. Many patients so soon become used to it, that at the end of a week it has lost its power of producing diuresis. A dose of the effervescing citrate in half a tumbler of water is a pleasant form in which to give caffeine.

Nervous system.—Occasionally it cures migraine, but it is not so useful as phenazone or exalgin.

It may be rendered sufficiently soluble for subcutaneous administration by mixing it with a solution of salicylate of sodium.

Diuretin.—(Not official.)

This is the name given to Theobromine-sodio-salicylate (which corresponds to Caffeine-sodio-salicylate, which is the salt of caffeine most used in Germany). It contains about 40 per cent. of theobromine and 60 per cent. of sodium salicylate; it is freely soluble in water.

Dose, 60 to 120 gr.

ACTION AND THERAPEUTICS.

Diuretin is a diuretic; it acts on the renal epithelium, and is most efficacious in diseases of the kidneys and heart. It is said not to produce much depression, but it may occasionally cause serious symptoms.

Guarana.—(Not official.)

Synonym.—Brazilian cocoa. The seeds of *Paullinia sorbilis* (Nat. Ord. *Sapindaceæ*). Brazil. They are roasted, powdered, and made into a stiff paste with water.

CHARACTERS.—Cylindrical rolls of dried paste.

COMPOSITION.—The chief constituent is *guaranine*, which is identical with caffeine (*see* p. 348) (**dose, ½ to 5 gr.**).

Dose, 10 to 60 gr., in powder or infused in a cup of boiling water.

Preparation (Brit. Pharm. Conference).

Elixir Guaranæ.—Guarana in powder, 4 fl. oz.; light magnesia, ½ fl. oz.; oil of cinnamon, 6 ℳ; syrup, 2 fl. oz.; proof spirit, q. s.

Dose, ½ to 2 fl. dr.

ACTION AND THERAPEUTICS.

Although there is no reason to believe that guaranine does not produce the same actions on the nervous system, heart, and kidneys as caffeine, yet it is rarely used except for sick headaches, but in these cases it is sometimes of great service.

CLASS II.—**Vegetable Drugs acting chiefly on the Spinal Cord.**

NUX VOMICA.

Nux Vomica.—*Synonyms.*—Poison nut. The dried, ripe seeds of *Strychnos nux vomica* (Nat. Ord. *Loganiaceæ*). East Indies. The St. Ignatius bean is *Strychnos Ignatia*, it is different in shape, and contains more strychnine.

CHARACTERS.—Disc-shaped, $\frac{7}{8}$ to 1 in. in diameter, $\frac{1}{4}$ in. thick. Flat or concavo-convex. Margin rounded. On one surface a central scar, from which a ridge passes to the margin, and ends in a slight prominence. Externally ashen grey, glistening with short satiny hairs. Internally horny and slightly translucent. No odour. Taste extremely bitter.

COMPOSITION.—The chief constituents are—(1) *Strychnine* (see p. 354), 0·2 to 0·6 per cent. (2) *Brucine*, $C_{23}H_{26}N_2O_4$, 0·5 to 1·0 per cent. Colourless prismatic crystals or pearly flakes. Very bitter, but less so than strychnine. *Solubility.*—1 in 3200 of cold water, freely in alcohol. It has the same action as strychnine, but is considerably less powerful and slower in its effects. Strong sulphuric or nitric acid gives a blood-red colour. (3) *Igasuric acid*, with which the strychnine and brucine are united. (4) *Sugar*. (5) *Fat*. (6) *Loganin*, a glucoside. (7) *Igasurine*, an alkaloid closely resembling the other two, has been said to be present.

Dose, 1 to 4 gr.

Preparations.

1. **Extractum Nucis Vomicæ Liquidum.**—Alcoholic. *Standardized to contain* 1·5 *per cent. of strychnine*, that is, $1\frac{1}{2}$ gr. in 110 ♏.

Dose, 1 to 3 m.

2. **Extractum Nucis Vomicæ.**—The liquid extract is evaporated and diluted with milk sugar. *Standardized to contain 5 per cent. of strychnine.*

This contains about $\frac{2}{3}$ of the amount of strychnine as in B. P. 1885.

Dose, $\frac{1}{4}$ to 1 gr.

3. **Tinctura Nucis Vomicæ.**—Liquid extract of nux vomica, 2 fl. oz.; water, 3 fl. oz.; alcohol (90 per cent.), q.s. Mix. *Standardized to contain* 0·25 *per cent. of strychnine*, that is, $\frac{1}{4}$ gr. in 110 ♏.

This contains about twice as much strychnine as in B. P. 1885.

Dose, 5 to 15 m.

Strychnina.—Strychnine. $C_{21}H_{22}N_2O_2$.

SOURCE.—This alkaloid is prepared from the dried ripe seeds of nux vomica and other species of strychnos.

CHARACTERS—Minute, colourless, odourless, trimetric prisms. Intensely bitter; can be tasted in a solution of 1 in 30,000 (but only to be tasted in weak solutions, as it is so poisonous). *Solubility.*—1 in 5760 of cold, 1 in 2500 of hot, water, 1 in 6 of chloroform, 1 in 150 of alcohol (90 per cent.). Gives no colour with nitric or sulphuric acids. Add to a crystal strong sulphuric acid, and then add a particle of potassium bichromate; a beautiful violet colour, passing to brown and green, is formed. *Resembling strychnine.*—Salicylic acid (*see* p. 421).

INCOMPATIBLES.—Alkalies, iodides, bromides; the last are especially dangerous, for the precipitated bromide of strychnine falls slowly.

IMPURITY.—Brucine, distinguished by tests.

Dose, $\frac{1}{60}$ to $\frac{1}{15}$ gr. in solution, or made in a pill with sugar of milk (to thoroughly divide it) and glycerin of tragacanth.

Preparation.

Syrupus Ferri Phosphatis cum Quinina et Strychnina.—Each fl. dr. represents $\frac{1}{32}$ gr. strychnine (*see* p. 173).

Dose, $\frac{1}{2}$ to 1 fl. dr.

Strychninæ Hydrochloridum. — Strychnine hydrochloride. $C_{21}H_{22}N_2O_2HCl,2H_2O$.

This was called hydrochlorate of strychnine in B. P. 1885.

CHARACTERS.—Small, colourless, trimetric prisms, which readily effloresce in air; very bitter. *Solubility.*—1 in 35 water, 1 in 60 alcohol (90 per cent.).

Dose, $\frac{1}{60}$ to $\frac{1}{15}$ gr.

Preparation.

Liquor Strychninæ Hydrochloridi. — *Synonym.*—Liquor Strychninæ. Strychnine hydrochloride, 17½ gr.; alcohol (90 per cent.), 1 fl. oz.; distilled water to make 4 fl. oz. *Strength.*—1 per cent.: that is, 1 gr. in 110 ♏.

Dose, 2 to 8 m. by the mouth; **1 to 4 m.** subcutaneously.

ACTION.

External.—Strychnine is a very powerful **antiseptic.** Brucine is a local anæsthetic.

Internal.—*Gastro-intestinal tract.*—Being intensely bitter, nux vomica is a good **stomachic,** increasing the vascularity of the gastric mucous membrane, the secretion of gastric juice, and the movements of the stomach, just like calumba, gentian, or any other bitter; consequently it aids digestion and sharpens the appetite. In the intestine it is a direct stimulant to the intestinal muscular coat, and by this means it **increases peristalsis,** and is therefore purgative.

Blood.—Strychnine is absorbed into the blood, and circulates as such. If blood is mixed with strychnine and shaken with air, it contains more oxygen and less carbonic acid than it would have done had the strychnine been absent; but there is no evidence that strychnine in small doses alters the oxidizing power of living blood.

Spinal cord.—Strychnine causes **convulsions.** They are not cerebral, for they occur if the spinal cord is separated from the brain. They do not depend upon excitation of the motor nerves or muscles, for they are absent in a limb the spinal anterior nerve-roots of which are cut. They do not depend upon stimulation of sensory nerves, for they occur even if the posterior nerve-roots are cut. Therefore they must be **spinal**; and this is proved by the fact that if all the vessels of the lower part of the spinal cord are ligatured just at their entry into the cord, so that this is the only part of the body deprived of its blood supply, and strychnine is injected into the blood, convulsions occur in all the muscles except those the nerves of which spring from the part of the cord which the strychnine cannot reach. Again, if an animal be convulsed by strychnine, and a probe be slowly passed down the spinal canal, the convulsions will gradually cease from above downwards. Strychnine, therefore, enormously increases the excitability of the motor nerve-cells of the spinal cord. The result is that even the slightest stimulus, as a breath of air, acting reflexly, causes violent convulsions.

Muscles and nerves.—Even with enormous doses the muscles and afferent nerves are unaffected. Towards the end of a case of poisoning the functional activity of the motor nerves is depressed. This is not due, as has been thought, to their exhaustion from the transmission of the impulses from the spinal cord which produce the convulsions, but it is the result of a direct paralysing effect on the motor nerves themselves.

Brain.—The **convolutions** are quite **unaffected.** The centres in the medulla, which are really the continuation upwards of the anterior cornual cells of the cord, are **powerfully stimulated**, especially the **respiratory centre.** The **vaso-motor centre** is also considerably **excited**, and chiefly for this reason the blood-pressure rises from the very first. The cardiac centre is but slightly affected.

Circulation.—Strychnine **stimulates the heart directly**, either by its action on the cardiac muscle, or, as most authorities think, by stimulating the motor ganglia. The **blood-pressure is raised**, partly no doubt by the action on the heart, but also by the contraction of the vessels all over the body, which is brought about first by the direct excitation by the strychnine of the medullary vaso-motor centre, and subsequently by its asphyxial stimulation, and also by the increased peripheral resistance which must occur from the frequent contraction of all the muscles.

Respiration.—Respiration is rendered **quicker and deeper** because strychnine excites the spinal and medullary respiratory centres. The respiratory muscles are implicated in the general convulsions, with the result that the patient ultimately becomes asphyxiated owing to exhaustion of them, and to their prolonged contraction during the convulsive spasms. The heart continues to beat after death, which is entirely due to failure of respiration. The temperature is a little raised during strychnine poisoning.

Special senses.—Smell, hearing, and sight are sharpened by strychnine. The field of vision, especially for blue, is enlarged.

Elimination.—Part of the strychnine is eliminated unchanged in the urine; the rest appears as strychnic acid. It is excreted very slowly, and therefore accumulates in the system. For a clinical account of strychnine poisoning *see* Toxicology.

Brucine and thebaine act like strychnine, but methylbrucine, methylthebaine, and methylstrychnine do not influence the cord, but paralyse the ends of the motor nerves like curare.

Strychnine acts on all animals as on man, but chickens, guinea-pigs, and perhaps monkeys are less susceptible to it than other animals.

THERAPEUTICS.

External.—Strychnine is so poisonous that its use as an antiseptic would not be safe.

Internal.—*Gastro-intestinal tract.*—Tincture of nux vomica is very largely given with excellent results as a bitter stomachic and carminative, especially in cases in which the feebleness of digestion is merely part of generally feeble health. A mixture of dilute hydrochloric acid, gentian, and nux vomica is of great service in these cases. As the digestion improves the general health improves. Because of its power to stimulate peristalsis, nux vomica is a valuable drug for cases of constipation in which the contractile strength of the muscular coat of the intestine is weak; usually this is part of a general weakness of the whole body. The constipation of anæmia, which can be very successfully treated by a pill of extract of nux vomica and iron sulphate, is a good instance of this variety of constipation.

Circulation.—In cases of heart disease in which digitalis is inadmissible, nux vomica and strychnine are excellent cardiac stimulants, and for this purpose they may be combined with caffeine. Patients almost dead from failure of the heart in the course of chronic cardiac disease may sometimes be brought round by the subcutaneous injection of strychnine.

Respiration.—Strychnine may be combined with expectorants because it stimulates the respiratory centre; and it is extremely serviceable when from any cause, such as severe bronchitis, the respirations are feeble and shallow.

Nervous system.—It has been given for a number of nervous diseases, but with no certain good results, for when the disease is not in the anterior cornua strychnine is hardly indicated; and if it is in this part of the cord, it is doubtful whether it is advisable to stimulate the part of the body which is diseased.

TOXICOLOGY.

In about an hour after a poisonous dose the patient begins to feel uneasy from a sensation of impending suffocation. The tetanic convulsions then commence with great violence, nearly all the muscles of the body being affected at once. The limbs are thrown out, the hands are clenched, the head is jerked forwards and then bent backwards, and the whole body is perfectly stiff from the violence of the contractions. The pulse is very rapid; the temperature may rise. Hearing and sight are acute. The convulsion lasts a minute or two, then the muscles relax, and the patient feels exhausted and sweats all over. The intermission is short, convulsions soon come on again, and again there is a relapse to the state of muscular relaxation. The convulsions now rapidly increase in severity, and owing to the violent contractions of the muscles of the back, the patient is in the position of opisthotonos, resting on his head and his heels. The abdominal muscles are as hard as a board, the chest is fixed, the face becomes livid, the eyeballs are staring. The contraction of the muscles of the face causes a risus sardonicus; but those of the jaw are not affected till quite the end. Consciousness is retained to the last. The slightest noise or even a bright light will reflexly bring on the convulsions, which may jerk the patient out of bed. Ultimately he dies from exhaustion and asphyxia. The smallest dose of strychnine known to have killed is half a grain. *Post mortem.*—The usual appearances of death by asphyxia are seen.

Strychnine poisoning is liable to be confounded with *tetanus*, but in this disease symptoms come on more slowly, the muscles of the jaw are implicated very early, and there is continuous muscular rigidity with paroxysmal exacerbations, but never complete muscular relaxation.

Treatment.—Give emetics (p. 129), or wash out the stomach if the case is seen early enough for the passing of the tube not to cause spasm. Also give plenty of animal charcoal or tannic acid, but continue the washing out. Inject large doses of potassium bromide and chloral hydrate *per rectum.* Use amyl nitrite inhalations, and if possible artificial respiration.

ANTAGONISM.

In a sense strychnine is antidotal to chloral and morphine, but it is not a strict antidote, for they act chiefly on the cerebrum. Still chloral is valuable in strychnine poisoning, and although the antagonism with Calabar bean and gelsemium is more accurate, as both depress the anterior cornua, yet they are of very little use in strychnine poisoning.

CALABAR BEAN.

Physostigmatis Semina. — *Synonym.*—Ordeal bean. The ripe seeds of *Physostigma venenosum* (Nat. Ord. *Leguminosæ*). Western Africa.

CHARACTERS.—1 to 1¼ in. long, ¾ in. broad, ½ in. thick. Oblong, slightly reniform, with a black furrow all along its convex border. Testa hard, brittle, rough, deep brown, enclosing two hard, white, brittle cotyledons separated by a cavity. Inodorous. No distinctive taste. Usually contains 0·12 per cent. of total alkaloids.

COMPOSITION.—The chief constituents are two alkaloids: (1) *Physostigmine* or *Eserine* (*see* below); (2) Calabarine.

Preparation.

Extractum Physostigmatis.—Alcoholic, with sugar of milk.

This is ¼ of the strength of that of B. P. 1885.

Dose, $\frac{1}{4}$ to 1 gr.—As this is not standardized it is unsuitable for internal administration, and it is better to give Physostigmine Sulphate in pill or solution.

Physostigminæ Sulphas.—$(C_{15}H_{21}N_3O_2)_2,H_2SO_4, xH_2O$. *Synonym.*—Eserine sulphate.

SOURCE.—The sulphate of an alkaloid obtained from Calabar bean.

CHARACTERS.—Yellowish-white, minute crystals, becoming red on exposure to light and air. Bitter taste. Very soluble in water and alcohol. The solution in salicylic acid is permanent.

Dose, $\frac{1}{60}$ to $\frac{1}{20}$ gr. Best given subcutaneously.

Preparation.

Lamellæ Physostigminæ.—Physostigmine sulphate, $\frac{1}{1000}$ gr.; gelatine and glycerin together, $\frac{1}{50}$ gr. in each lamella.

ACTION.

External.—None.

Internal.—*Mouth.*—After physostigmine is absorbed it **increases the salivary secretion**; and this, according to some, is through its action on the centre in the medulla, according to others by its direct effect on the salivary cells. After a time the flow of saliva ceases, because the drug has so acted on the circulation as to constrict the vessels, and consequently the flow of blood through the salivary glands is diminished.

Stomach and intestines.—The **muscular coat** of the stomach and intestines is greatly **stimulated** by the direct action of the drug circulating through it. The result is that after a large dose vomiting and purging occur. Physostigmine is quickly absorbed.

Circulation.—No influence on the blood is known. The effect on the heart is obscure, but it appears that the irritability of the peripheral terminations of the vagus is at first increased, and that consequently the heart is **slowed**. Very large doses are said to decrease the irritability of the vagus. In addition to its effects on the vagus physostigmine powerfully stimulates the contractile force of the heart. The

beat is therefore both more **forcible** and slower. Ultimately the organ is paralysed and stops in diastole.

The **blood-pressure rises** very much; this is largely due to the increased force of the cardiac beat, but perhaps partly to the irritation of the muscular coat of the arteries by physostigmine, for it **stimulates most of the involuntary muscles** in the body.

Respiration is first quickened but soon retarded, and **death** takes place from **asphyxia.** Three factors at least are probably concerned in bringing about these results. The ends of the vagi in the lungs are stimulated, for if these nerves are cut and physostigmine is administered there is no primary quickening of respiration. Physostigmine, from its action on involuntary muscular fibre, causes contraction of that in the bronchial tubes, with consequent constriction of them. Lastly and most importantly, the activity of the respiratory centres in the medulla and cord is depressed.

Nervous system.—Brain.—Even in fatal doses consciousness is unimpaired. The only part of the brain known to be affected is the respiratory centre.

Spinal cord.—It is here that physostigmine produces its most characteristic effects. **Reflex activity is inhibited**; by exclusion it can be shown that this is not owing to any influence on the nerves or voluntary muscles, therefore it is due to depression of the **anterior cornua** of the spinal cord. The most conclusive proof of this is the direct application of the drug to the cord. There is, then, at first, from the irritation, which is caused by almost any substance, a slight increase of reflex excitability, but this soon gives way to complete abolition of it. Later on the posterior part of the cord is also paralysed, so that there is a diminution of cutaneous sensibility.

Voluntary muscles and their nerves.—These are but slightly influenced. With very large doses the irritability of motor nerves and muscles is slightly depressed; sensory nerves are unaffected.

Involuntary muscles.—We have already seen that the involuntary muscles of the intestines, stomach, and bronchial tubes are stimulated by physostigmine; so also are those of the spleen, uterus, bladder, and iris. It is not decided whether in all these instances it is the muscular fibres or the terminations of the nerves in them that are affected.

Eye.—Physostigmine applied locally to the conjunctiva or introduced into the circulation causes **contraction of the pupil, spasm of accommodation** from direct stimulation of the circular fibres of the iris and the ciliary muscle. There is a **diminution of intraocular tension.** These effects can be prevented by atropine. Some consider that the ends of the third nerve are also affected.

Secretions.—The saliva, sweat, tears, and buccal mucus are increased. The cause of this is unknown.

The action of physostigmine is much more constant than that of Calabar bean, because the calabarine (which stimulates the cord) in the bean interferes with the action of physostigmine.

THERAPEUTICS.

Involuntary muscles.—Because of its stimulating power on unstriped muscle Calabar bean has been recommended for chronic constipation, atony of the bladder, and chronic bronchitis with deficient power of expectoration, but it is rarely given for these purposes.

Spinal cord.—Calabar bean has been largely used for tetanus, and some cases of recovery have been reported. It must be administered boldly. The extract has often been given, but it is better to inject physostigmine sulphate under the skin. Doses of $\frac{1}{30}$ gr. frequently repeated may be employed, but the patient must be carefully watched. Physostigmine has been given as an antidote for strychnine poisoning.

Eye.—The lamellæ are placed in the eye to break up adhesions of the iris, to diminish intra-ocular tension, and to prevent prolapse of the iris after wounds or ulcers of the cornea. It is also employed in glaucoma, in paralysis of the iris and ciliary muscles, and to prevent the entrance of light into the eye in photophobia. If used in solution, $\frac{1}{2}$ to 2 gr. of physostigmine sulphate to 1 fl. oz. of water is the usual strength.

ANTAGONISMS.

It will be observed that in its actions on the pupil, on secretion, on the heart, and on respiration, physostigmine is antagonistic to atropine. In its action on the spinal cord and respiratory centre it is antagonistic to strychnine.

GELSEMIUM.

Gelsemii Radix.—Yellow Jasmine. The dried rhizome and rootlets of *Gelsemium nitidum* (Nat. Ord. *Loganiaceæ*). From the south-eastern United States.

CHARACTERS.—Nearly cylindrical, about 6 in. long, $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter, often small rootlets mixed with or attached to the larger pieces; light yellowish brown externally, with longitudinal wrinkles; bark thin; fracture splintery; body-axis pale yellow, porous, with medullary rays. Odour aromatic. Taste bitter.

COMPOSITION.—The chief constituents are—(1) Gelseminine a powerful yellowish-brown, bitter alkaloid, soluble in alcohol and ether, sparingly in water. (2) Gelsemine, an alkaloid. The hydrochloride is the common salt. (3) A volatile oil.

Dose, of gelsemine hydrochloride, **$\frac{1}{60}$ to $\frac{1}{20}$ gr.**

Preparation.

Tinctura Gelsemii.—Gelsemium, 1; alcohol (60 per cent.), 10. Percolate.

Dose, 5 to 15 m.

ACTION.

External.—None.

Internal.—Gelsemium produces no effect on the stomach or intestines.

Brain.—In poisoning by gelsemium consciousness is maintained till the end; the drug, therefore, has no power on the higher cerebral centres.

Spinal cord.—The most marked symptom produced by gelsemium is **paralysis of all the muscles** of the body; and by a series of experiments, like those used for strychnine, this can be shown to be due to **depression of the activity of the anterior cornua** of the spinal cord. This is said to be followed by a depression of the sensory part of the cord, with consequent anæsthesia. The motor nerves are quite unaffected till just before death, when the end plates are paralysed. The result of the action on the cord is that the patient may be unable to walk, or if he can the gait is staggering; his general sensibility is much impaired. Convulsions may be produced. The cause of these cannot be made out, for they appear to be neither cerebral, spinal, nor peripheral.

Eye.—Gelsemium soon causes disturbance of vision, then follows **diplopia**, due to **paralysis** of the **ocular muscles**, and from the same cause the upper lid drops. The **pupil is dilated.** All these symptoms are probably owing to the paralysis of the motor cells in the floor of the fourth ventricle and the aqueduct of Sylvius, for these are the continuation upwards of the anterior cornual cells.

Circulation.—The action of moderate doses is not marked. Toxic doses are powerfully depressant; the force and rate of the pulse and the blood-pressure fall. This is owing to a direct action on the ends of the vagus. How far these effects are due also to affection of the medullary and spinal centres is not known.

Respiration.—Soon after the administration of gelsemium the respiration becomes slower and more feeble; ultimately it stops, death taking place by **asphyxia.** This is due to paralysis of the respiratory centres in the cord and medulla. Before death the temperature falls, and the skin is bathed in a cold sweat.

THERAPEUTICS.

Gelsemium was formerly given for many conditions, but as it did no good and is an uncertain, very powerful poison, it should not be prescribed; but occasionally—usually unsuccessful—it is used for neuralgia and migraine. Formerly, too, it was employed to dilate the pupil and paralyse accommodation. It will do this when applied locally, for it is quickly absorbed from the eye. Discs, each containing $\frac{1}{500}$ gr. gelsemine, are made for application to the eye.

CLASS III.—**Vegetable Drugs acting chiefly on Nerves.**

CONIUM.

Conii Folia.—Hemlock Leaves. The fresh leaves and young branches of *Conium maculatum*, the spotted hemlock (Nat. Ord. *Umbelliferæ*), collected when the fruit begins to form (in June).

CHARACTERS.—Divided pinnately; lower leaves decompound, and sometimes 2 feet long; glabrous, arising from a smooth stem marked with purple spots, by clasping petioles of varying lengths, those of the lower leaves being hollow. Odour of the leaves strongly like that of mice and very disagreeable, especially if they are rubbed with a solution of potash.

INCOMPATIBLES.—Caustic alkalies, vegetable acids, and astringents.

COMPOSITION.—Same as the fruit—*see* below.

Preparations.

1. Succus Conii.—Juice of fresh hemlock leaves and branches, 3; alcohol (90 per cent.), 1.
Dose, 1 to 2 fl. dr.

2. Unguentum Conii.—Succus Conii, 2 fl. oz.; hydrous wool fat, $\frac{3}{4}$ oz.

Conii Fructus.—Hemlock Fruit. The dried fully grown but unripe fruit of *Conium maculatum* (Nat. Ord. *Umbelliferæ*).

Characters.—About $\frac{1}{8}$ in. long, broadly ovoid, compressed laterally, dull greenish grey, and crowned by the depressed stylopod. In commerce consists usually of the separated mericarps, each having five prominent more or less crenated ridges, the furrows smooth and without evident vittæ. Powdered and rubbed with potash, it gives off a strong disagreeable odour due to the alkaloid. *Resembling conium fruit.*—Caraway, anise, dill, all known by having vittæ.

Composition.—The chief constituents are—(1) *Conine*, $C_8H_{16}HN$, the active principle. A yellowish, oily, strongly alkaline liquid alkaloid, with a mouse-like odour and a tobacco-like taste. *Solubility.*—1 in 100 of water. It is easily obtained from the plant by distillation with alkalies. It is most abundant in the fruit. It is readily decomposed by light and heat, and the preparations of conium are therefore of very varying strengths. Its salts are much more stable. (2) Methyl-conine, $C_8H_{14}CH_3N$. A colourless fluid alkaloid. (3) Conhydrine, a nearly inert crystallizable alkaloid. (4) Coniic acid.

Incompatibles.—Caustic alkalies, vegetable acids, and astringents.

Preparation.

Tinctura Conii.—Hemlock fruit, 1; alcohol (70 per cent.), 5. Percolate.

Dose, 30 to 60 m.

Action.

External.—Conine has no influence on the unbroken skin, but it has been thought to be anæsthetic when applied to painful broken surfaces. This is doubtful, for in the first place we have no proof that it can be absorbed from sores; and, secondly, experiments show that enormous doses have to be given to depress the activity of sensory nerves.

Internal.—*Gastro-intestinal tract.*—It has no special action here, but it may occasionally give rise to vomiting and diarrhœa.

Circulation.—Conine is absorbed into the blood, and circulates unchanged. As it paralyses the terminations of the vagus it probably increases the rapidity of the cardiac beat, but this subject has not yet been satisfactorily worked out.

Nervous system.—Nerves.—It is on these that conine and methylconine, the active principles of conium, chiefly act. Conine is much the more energetic. It powerfully **depresses** the functional activity of all **the motor nerves** in the body. This depression begins at their periphery, and gradually **ascends** till the whole nerve, from the periphery to the spinal cord, is incapable of responding to stimuli. This leads to paralysis of all the muscles of the body as far as voluntary and reflex motion are concerned, but they themselves are unaffected, retaining their irritability to local stimuli. The sensory nerves are not implicated unless the dose is very large; then their conducting power is slightly impaired.

Spinal cord.—This remains uninfluenced till quite late; then, if poisonous doses have been given, the function of its motor cells is feebly depressed, as is also that of the respiratory centre in the medulla. As methylconine inhibits the reflex activity of the spinal cord earlier than conine, the exact period at which this effect comes on varies with different preparations.

Brain.—Except for the respiratory centre, the whole of the brain is unaffected by conine. Consciousness is preserved until the stage of asphyxia.

Eye.—Conine, when dropped into the eye, causes immediate contraction of the pupil reflexly from the conjunctival irritation. But soon the **pupil dilates,** and accommodation is paralysed; the same usually happens when the drug is given internally. Probably these results are owing to paralysis of the terminal portions of the third nerve, for well-marked **ptosis,** which is due to this cause, is present.

Respiration.—Owing to the profound paralysis of all the motor nerves, and the later depression of the respiratory centre and motor part of the cord, death takes place from enfeeblement of respiration and consequent **asphyxia.**

Conine is excreted unchanged, chiefly in the urine.

THERAPEUTICS.

External.—Conium has been applied to painful ulcers and sores, but it is, for the reasons already given, doubtful whether it produces any good effect. It has also been employed for myalgia and rheumatism, but it is quite useless.

Internal.—Conium is rarely given as a medicine for (*a*) the amount of conine extracted by any preparation is very variable ; (*b*) the amount of methylconine present is also very uncertain ; (*c*) conine is very volatile ; (*d*) it is unstable, light and air making it inert. For these reasons it is probable that often the pharmacopœial preparations contain no conine at all. Ounces of the succus, which is believed to be the most reliable preparation, have frequently been swallowed without producing any effects. The preparation of the fruit is said by some to be more reliable than those of the leaves. Conium has been given in spasmodic diseases, as whooping-cough, in chorea, tetanus, asthma, and epilepsy, but in all it does little or no good.

TOXICOLOGY.

The symptoms produced by a poisonous dose are in strict accordance with the physiological action. The sufferer feels his legs to be heavy ; on attempting to walk he staggers, and finds he can hardly move them, and finally he has to lie down because he has no power over them. The arms become powerless, and lie motionless at his side. There is ptosis, and dimness of vision from paralysis of accommodation ; the eyes are fixed, the pupil is dilated. Swallowing becomes difficult. Respiration is laboured, the voice is lost, and death takes place from asphyxia. *Post mortem.*—The organs are found congested with venous blood.

Treatment.—Emetics (p. 129), and wash out the stomach. Give tannic acid and again wash it out. Stimulants subcutaneously. Warmth to the feet. Artificial respiration.

Tabaci Folia.—(Not official.)

Tobacco Leaves. The dried leaves of *Nicotiana tabacum* (Nat Ord. *Solanaceæ*).

CHARACTERS.—Large, up to 20 or more in. long, ovate, acute, entire, brown, brittle, glandular, hairy. Odour characteristic. Taste nauseous, bitter, acrid.

COMPOSITION.—The chief constituents are—(1) *Nicotine*, $C_{10}H_{14}N_2$ (2–8 per cent.). A colourless, volatile, oily alkaloid, smelling and tasting like tobacco leaves, darkening with age. Soluble in water, more so in alcohol and ether. Turkish tobacco contains hardly any. (2) Nicotianin. (3) Salts and flavouring agents.

Nicotine is decomposed by heat, consequently tobacco smoke contains none, but consists of small quantities of various pyridine compounds, as pyridine (C_5H_5N), picoline (C_5H_7N), lutidine (C_7H_9N), and collidine ($C_8H_{11}N$), and small amounts of hydrocyanic and acetic acids, creosote, sulphur, and carbon compounds.

ACTION.

Tobacco leaves, when taken internally, act in virtue of their nicotine, which is one of the **most powerful and rapid poisons** known.

External.—Nicotine is an antiseptic.

Internal.—*Gastro-intestinal tract.*—Nicotine in even minute doses ($\frac{1}{7}$ gr.) promptly produces symptoms of **intense gastro-intestinal irritation.** They are greatly increased salivary flow, burning pain in the mouth, œsophagus, and stomach, horrible nausea, quickly succeeded by vomiting and free purging. The marked characteristic of this gastro-intestinal irritation is the **extreme collapse** which accompanies it. Thus there are a rapid, very feeble pulse, intense muscular weakness, laborious respirations, partial loss of consciousness, occasional convulsions, icy extremities, and profound general collapse. A dose of nicotine has been known to kill in three minutes.

Circulation.—Nicotine disintegrates the red blood-corpuscles of freshly drawn blood, but has not this effect on living blood, although the spec-

trum of hæmoglobin is **altered**, so that the corpuscles must be in some way affected. The action on the heart is obscure ; the muscle itself is unaffected, but the rapid running feeble pulse shows that some part of the cardiac apparatus is powerfully influenced. The blood-pressure falls rapidly ; we are ignorant as to whether this is entirely due to the action of nicotine on the heart.

Respiration.—This is **paralysed**, how is not known. Death is partly due to asphyxia.

Nervous system.—The cerebrum is probably very little affected by nicotine. The convulsions occasionally observed in man, and always in the frog, are due to spinal stimulation. All observers are agreed that ultimately the **function of the motor nerves is entirely abolished.** This explains the intense muscular weakness. Probably the sensory nerves, and certainly the muscles, escape.

Eye.—A toxic dose taken internally, or the local application of nicotine to the eye, **contracts** the **pupil.** This will occur in excised eyes, and is therefore a local effect. It is most likely due both to sympathetic paralysis and irritation of the third nerve.

Elimination.—Nicotine is probably eliminated in the urine, the secretion of which it increases.

THERAPEUTICS.

Tobacco is never used therapeutically. Formerly it was employed in the form of an enema of the leaves to relax muscular spasm, so as to facilitate the reduction of dislocations. This enema was also sometimes given as a purgative.

Tobacco smoking, in those who are unaccustomed to it, produces, to a greater or less degree, the symptoms of gastro-intestinal irritation and collapse just mentioned. Even in those who are used to it the smoke may produce catarrh of the pharynx. Some persons find smoking after breakfast assists the daily action of the bowels. With many people it has an obscure effect, especially among those who lead sedentary lives, in stimulating the brain and producing a peaceable, calm state of mind. Over-indulgence in it may lead to loss of appetite and atrophy of the optic nerve.

COCA.

Cocæ Folia. *Synonym.*—Cuca. The dried leaves of *Erythroxylum coca*, and other species of Erythroxylum (Nat. Ord. *Lineæ*). South America.

Characters.—1½ to 3 in. long, 1 to 1½ in. wide; brownish-green, oval, entire, glabrous; upper surface has a distinct ridge above midrib, under surface curved line either side of it, but the ridge and curved lines, while well marked in specimens from Bolivia, are usually absent in those from Peru, which are smaller. Faint tea-like odour, bitter taste.

Composition.—It contains three alkaloids, viz. (1) *cocaine* (q. v.), which is methylbenzoylecgonine, 0·2 per cent.; (2) isatrophyl-cocaine; (3) cinnamyl-cocaine. Also (4) coca tannin and (5) coca wax. Different specimens vary very much in strength of cocaine. Fresh specimens are stronger than those that have been kept.

Incompatibles.—Mineral acids (decompose cocaine into benzoic acid and ecgonine), sodium bromide, salts of mercury, menthol, and silver nitrate.

Preparation.

Extractum Cocæ Liquidum.—Powdered leaves and alcohol (60 per cent.), equal parts.

Dose, ½ to 1 fl. dr.

Cocaina.—Cocaine. $C_{17}H_{21}NO_4$.

Source.—An alkaloid obtained from Coca Leaves.

Characters.—Colourless monoclinic prisms with a bitter taste followed by numbness. *Solubility.*—Almost insoluble in water. 1 in 10 alcohol (90 per cent.); 1 in 4 ether; 2 in 1 chloroform; 1 in 12 olive oil.

Preparation.

Unguentum Cocainæ.—Coc inc, 1; oleic acid, 4; lard, 20.

Cocainæ Hydrochloridum.—Cocaine Hydrochloride. $C_{17}H_{21}NO_4,HCl$.

The hydrochloride of an alkaloid obtained from Coca Leaves.

This salt was called the hydrochlorate of cocaine in B. P. 1885.

CHARACTERS.—Colourless acicular crystals or a crystalline powder. *Solubility.*—2 in 1 of water, 1 in 4 of alcohol (90 per cent.), 1 in 4 of glycerin. The solution has a bitter taste, it produces in the mouth a slight tingling followed by prolonged numbness. It is said to keep better if $\frac{1}{2}$ per cent. solution of boric acid be added to it.

Dose, $\frac{1}{5}$ to $\frac{1}{2}$ gr.

Preparations.

1. Injectio Cocainæ Hypodermica.—Cocaine Hydrochloride, 33 gr.; salicylic acid (to preserve the solution), $\frac{1}{2}$ gr.; water, 6 fl. dr. *Strength.*—10 per cent. **Dose, 2 to 5 m.** subcutaneously.

2. Lamellæ Cocainæ.—Discs of gelatin and glycerin each weighing $\frac{1}{30}$ gr., and containing cocaine hydrochloride $\frac{1}{50}$ gr.

Each is four times the strength of those in B. P. 1885.

3. Trochiscus Krameriæ et Cocainæ.—Each contains extract of krameria 1 gr., cocaine hydrochloride $\frac{1}{20}$ gr., with a fruit basis.

ACTION.

External.—Cocaine has no action on the unbroken skin, but if injected subcutaneously or applied to mucous membranes—as, for example, those of the eye, nose, mouth, rectum, vagina—it produces **complete local anæsthesia,** so that small operations can be performed without the patient feeling them. A 5 or 10 per cent. solution of the hydrochloride is strong enough to thus paralyse the sensory nerves. Much larger doses must be applied to motor nerves to paralyse them.

Internal.—*Gastro-intestinal tract.*—Applied to the tongue cocaine abolishes taste, and when it is taken internally, the gastric mucous membrane experiences its anæsthetic influence. Therefore the sensation of hunger is deadened, and persons taking cocaine can go a long while without feeling the want of food; but the drug is not a food, for the body rapidly wastes. Because of its local anæsthetic effect it sometimes stops vomiting. Very large doses, according to some, by paralysing the intestines, lead to constipation, but others assert that diarrhœa results.

Circulation.—Probably cocaine has little direct effect upon the circulation, but the vagus is somewhat depressed, and therefore the pulse quickens; larger doses slow it from stimulation of the vagus.

Respiration.—It acts upon the respiratory centre, first stimulating it, so that the rapidity and depth of respiration are increased; but soon depression of the centre follows, the respiratory movements become feeble, and death takes place from **asphyxia.**

Nervous system.—*Cerebrum.*—Moderate doses greatly **increase the bodily and mental power,** and give a sense of calm and happiness. This greater physical energy renders possible the performance of long, exhausting muscular feats. For this, and for the extreme sense of peace produced, coca leaves mixed with clay or ashes are chewed by thousands of the inhabitants of Peru and the neighbouring countries. It is said that forty million pounds of the leaves are annually harvested. An excessive indulgence in the habit of coca chewing leads to indigestion, extreme emaciation, insomnia, and enfeeblement of intellect. In animals coca causes cerebral convulsions.

Spinal cord.—The effect of cocaine on this is obscure. Large doses are depressant. The action on nerves has been already mentioned. As a rule muscles are unaffected.

Eye.—When a solution of cocaine is dropped into the eye there is first a transitory contraction of the pupil. This is probably due to reflex action, and soon it gives way to **wide dilatation.** The maximum is attained in an hour or two. The normal state is regained in from twelve to twenty-four hours. The dilated pupil is feebly responsive to light, and the dilatation is rapidly overcome by physostigmine. The ocular tension is slightly lowered. Accommodation is partially, but never completely, paralysed. These effects are **due to irritation of the sympathetic**, and as they are quickly produced by dropping the drug in the eye they are probably **local.**

Temperature.—This may rise in cocaine poisoning.

Kidneys.—Cocaine is most likely execreted by these organs. It increases the quantity of urine passed, and diminishes the excretion of urea. It diminishes sexual excitability.

THERAPEUTICS.

External.—A 5 to 10 per cent. solution of the hydrochloride may be injected subcutaneously as a local anæsthetic when any small operation has to be performed. Solutions (4 to 10 per cent.) painted or dropped on may be used for operations on the mouth, eye, ear, throat, teeth, vagina, urethra, and rectum, and they may be applied to any of these parts when they are very painful. Cocaine will relieve vaginal pruritus, and has been used locally to the nose in hay fever. Painful ulcers, fissures, &c., are beneficially treated with it. Ointments, bougies, and suppositories, usually containing 2–5 per cent. of cocaine, which mixes better than the hydrochloride, are very useful. A 15 per cent. solution has been injected into the gums for tooth extraction, but is not strongly recommended. Oculists employ cocaine very largely to produce local anæsthesia of the eye.

Internal. — *Mouth.* — A solution is useful for painting or spraying on to the throat previous to laryngeal examinations. The lozenges of Krameria and Cocaine are valuable for painful sore throats.

Stomach.—Cocaine in some cases allays excessive vomiting, and has been said to cure sea-sickness.

It is not often used in Europe as a medicine for its restorative effects; as already mentioned, it is not a food, and the good it does is only temporary. It is a respiratory depressant; but poisoning symptoms have been rarely noticed unless the drug has been injected under the gums or skin. Then it may cause vertigo, pallor, and fainting.

Chronic Cocaine Poisoning.—Synonym, Cocomania.—The sufferer takes cocaine either for its pleasant effects or because he thinks it will help him to break himself of the morphine habit, or he takes it with morphine. It is usually administered subcutaneously. The pulse is rapid, and fainting is common. There is much wasting and the patient looks pale and death-like. Usually he suffers from insomnia and he may become acutely maniacal with delusions of persecution. Visual and other hallucinations are often present, and it is very characteristic that patients complain of little animals creeping on the skin, 'cocaine bugs,' they say. They are extraordinarily prolix in both conversation and writing.

JABORANDI.

Jaborandi Folia.—The dried leaflets of *Pilocarpus jaborandi* (Nat. Ord. *Rutaceæ*). Paraguay.

CHARACTERS.—Leaflets very shortly stalked, about 3 in. long; oval-oblong or oblong-lanceolate, unequal at base; obtuse and emarginate; slightly revolute and entire at the margins; coriaceous. Upper surface glabrous, dull green; under surface paler, often hairy, with prominent midrib and pellucid dots. Odour when bruised aromatic. Taste on chewing slightly bitter and aromatic at first, subsequently pungent, and increasing the flow of saliva.

IMPURITY.—Leaves of species of *Piper*, not oval-oblong.

COMPOSITION.—The chief constituents are—(1) A liquid, colourless alkaloid *pilocarpine*, $C_{11}H_{16}N_2O_2$, $\frac{1}{4}$ to 1 per cent. (2) Jaborine, $C_{22}H_{32}N_4O_4$, an alkaloid resembling in its physiological action atropine, and therefore antagonistic to pilocarpine. (3) A volatile oil. (4) A peculiar acid. These active principles are soluble in alcohol, but only imperfectly so in water.

Preparations.

1. **Extractum Jaborandi Liquidum.**—Jaborandi leaves and alcohol (45 per cent.), equal parts.
Dose, 5 to 15 m.

2. **Tinctura Jaborandi.**—Powdered leaves, 1; alcohol (45 per cent.), 5. Percolate.
Dose, $\frac{1}{2}$ to 1 fl. dr.

Pilocarpinæ Nitras.—Pilocarpine Nitrate. $C_{11}H_{16}N_2O_2,HNO_3$.

Source.—Obtained from jaborandi leaves.

Characters.—A white crystalline powder. *Solubility.*—1 in 9 of water, 1 in 50 of cold, freely in hot alcohol (90 per cent.)

Dose, $\frac{1}{20}$ to $\frac{1}{2}$ gr. by the mouth, **$\frac{1}{10}$ to $\frac{1}{3}$ gr.** hypodermically.

Action.

External.—None.

Internal.—*Gastro-intestinal tract.*—Pilocarpine is very quickly absorbed, and soon produces a **great increase in the amount of salivary secretion.** The mouth seems warm, and there may be a feeling of tenseness about the salivary glands. The saliva contains an abundance of salts and ptyalin, and can convert starch into sugar. Its increase is due to a direct stimulation of the filaments of the chorda tympani and other nerves which end in the cells of the salivary glands, so that stimulation of these nerves can add very little to the flow produced by the drug—in fact, not more than can be accounted for by vascular alterations. This action is antagonized immediately by belladonna, as that paralyses the endings of these nerves. To a slight extent pilocarpine excites the secretion of the gastric juice and intestinal fluid. The unstriped muscle of the stomach and intestine is stimulated, and thus the drug may purge. The bile is unaffected. Large doses, especially of jaborandi, may produce vomiting.

Circulation.—Pilocarpine has no effect on the blood, but it is a **cardiac depressant.** The pulse-rate, it is true, may be, and in the human being always is, a little accelerated at first, but soon both it and the blood-pressure fall. This slowing of the pulse is at once set aside by atropine, but is not prevented by section of the vagus, therefore pilocarpine acts on the heart itself, probably stimulating the terminations of the vagus. The blood-vessels are at first dilated.

Respiration.—The drug has no effect on this. The amount of bronchial secretion is increased.

Skin.—Jaborandi, through its alkaloid pilocarpine, produces a very **profuse** secretion **of sweat.** It is the most powerful diaphoretic drug we have. A single dose may cause the flow of fifteen fluid ounces of sweat. It is said that the proportion of urea and chlorides in the sweat is greatly increased. This profuse diaphoresis is due to the action of the pilocarpine on the cells of the sweat-glands, or the terminations of the nerves in them, and is stopped by atropine. The skin may flush, but this is not the cause of the diaphoresis. Under a course of jaborandi the hair grows more actively, but it becomes very coarse and dark.

Kidneys.—If the sweating is profuse the secretion of urine is lessened, but repeated small doses of pilocarpine lead to slight diuresis. It is excreted unchanged in the urine.

Temperature.—There may be a slight rise at first, but soon the temperature falls considerably. This is probably due in large part to the evaporation of the perspiration.

Eye.—Whether applied locally to the eye or given internally, pilocarpine produces **great contraction of the pupil**, due to stimulation of the ends of the third nerve in the eye, and this is antagonized by atropine. It also causes increased tension of the eyeball, and an approximation of the nearest and farthest points of distinct vision.

Other actions.—It stimulates the uterus, and has in very rare cases produced abortion. It increases the secretion of milk, of tears, of nasal mucus, and, according to some authors, that of cerumen. It causes the spleen and bladder to contract.

It will be noticed that it has two main actions: (1) It stimulates the secretions, viz. those of the salivary glands, stomach, intestines, skin, kidney, bronchial mucous membrane, nose, lachrymal glands, and ear. In those that have been investigated, and probably in all, it acts locally. It has not been decided in every case whether the cells of the glands or the nerve terminations in them are affected. (2) It stimulates the nerve terminations of involuntary muscles, viz. in the eye, the intestines, the stomach, the uterus, the spleen, the heart, the bladder, and it acts on the muscular coat of the vessels, although these, if affected, are usually dilated. The most important effects are the diaphoresis, the salivation, and the myosis. It is consequently antagonistic in its action to belladonna. Children bear large doses of it well. Pilocarpine is much more used than jaborandi, as it is more prompt and more certain in its action, and is less likely to cause indigestion.

Jaborine has an action similar to that of atropine; the amount of it in jaborandi varies, hence the varying effects of different specimens of the leaves; but there is never enough to totally counteract the pilocarpine.

THERAPEUTICS.

External.—Pilocarpine has been used locally to promote the growth of the hair. An ointment (Pilocarpine nitrate, 4 gr.; vaseline, ½ oz.; lanolin, ½ oz.) and a lotion (Pilocarpine nitrate, 2 gr.; quinine hydrochloride, 8 gr.; glycerin, 2 fl. dr.; aqua rosæ, 6 fl. dr.) have been used.

Internal.—Pilocarpine has been employed for many conditions, but its great use is as a diaphoretic in Bright's disease. For this purpose $\frac{1}{6}$ of a grain or more of the nitrate is injected subcutaneously in the evening. The sweating is aided by wrapping the patient, who should be naked, in several warm blankets, and putting a hot water bottle to his feet. After the sweating has ceased, he should be dried and left in a dry blanket. As it is such a powerful cardiac depressant, it must be given with great caution when the heart is diseased. Occasionally it is employed locally in affections of the eye. Patients suffering from deafness, due to disease of the auditory nerve or its terminations, are sometimes relieved by pilocarpine. Injected subcutaneously it has been given successfully as an antidote to belladonna poisoning.

Curara.—(Not official.)

Synonyms.—Curare, Ourari, Urari, Wourara, Wourali. The South American arrow poison, prepared from species of *Strychnos* and other plants.

CHARACTERS.—A blackish-brown, dry, bitter extract.

COMPOSITION.—It contains an extremely active poison, curarine or curarina, a yellowish-brown powder, intensely bitter.

Dose, $\frac{1}{20}$ to $\frac{1}{2}$ gr.

Preparation (Brit. Pharm. Conference).

Injectio Curaræ Hypodermica.—Curare, 5 gr.; add distilled water to form a thin paste. Put in a funnel plugged with absorbent wool, and gradually add more water till a drachm is obtained.

Dose, 1 to 6 m. (subcutaneously).

Lamellæ or discs, each containing $\frac{1}{20}$ of a grain, are also prepared. They are dissolved in a few minims of water before injection subcutaneously.

ACTION AND THERAPEUTICS.

The physiological action of curare, by which it paralyses the end plates of the motor nerves of voluntary muscle, is well known. It has been given successfully in tetanus, and is probably the most useful of all the drugs employed for this very fatal disease.

GROUP II.

Vegetable Drugs whose Main Action is on the Heart.

CLASS I.—The digitalis group, decreasing the frequency and increasing the force of the beat of the heart:

Digitalis. Strophanthus. Squill. Convallaria. Erythrophlœum.

Class II.—The aconite group, decreasing the frequency and decreasing the force of the beat of the heart :

Aconite. Veratrine.

Class I.—The Digitalis Group.

DIGITALIS.

Digitalis folia.—Digitalis Leaves. *Synonym.*—Foxglove Leaves. The dried leaves of *Digitalis purpurea* (Nat. Ord. *Scrophulariaceæ*), the purple foxglove. Collected from plants commencing to flower.

Characters.—4–12 in. long, up to 6 in. broad, with a winged petiole ; ovate, subacute, crenate ; somewhat rugose ; hairy dull green above, densely pubescent and paler beneath. Odour faint. Taste very bitter, unpleasant.

Composition.—The chief constituents are—(1) Digitoxin, a glucoside, the most active principle, very poisonous, cumulative. Insoluble in water, sparingly in alcohol and in ether. (2) Digitalin, a crystalline glucoside insoluble in water. (3) Digitalein, an amorphous glucoside, soluble in water, and therefore suitable for hypodermic injections ; dose hypodermically $\frac{1}{100}$ gr., said to be non-cumulative. These three glucosides are said to represent the cardiac stimulating action of the drug. (4) Digitonin, a glucoside closely allied both chemically and physiologically to, and perhaps identical with, the senegin of senega (*see* p. 401). This is a cardiac depressant, and is therefore antagonistic to the other three glucosides. (5) Digitin, a substance devoid of physiological action. All these five bodies are non-nitrogenous. (6) Two acids, digitalic and antirrhinic. (7) Other usual constituents of plants, as tannin, volatile oil, colouring matter, starch, sugar, gum, salts. It will be noticed that digitalis contains no alkaloids.

The following four substances are met with in commerce:—

(A) Homolle's digitalin (same as Quévenne's digitalin), an amorphous yellowish-white powder or small scales, intensely bitter, inodorous, but irritating to the nostrils. Consists chiefly of digitalin with a little digitoxin. Possesses the action of the leaves. Granules of it are much used in France ; each usually contains $\frac{1}{65}$ of a grain, which is equal to $1\frac{1}{2}$ gr. of the powdered leaves.

(B) Nativelle's digitalin : light white crystalline tufts of needles, very bitter. Soluble in chloroform and in alcohol (90 per cent.), not in water or ether. It consists very largely of digitoxin, and is cumulative. Dose, $\frac{1}{60}$ to $\frac{1}{30}$ gr. in a pill.

(C) German digitalin, consisting chiefly of digitalein.

(D) Digitalin verum, which consists almost entirely of digitalin.

Incompatibles.—Per-salts of iron (see p. 388), lead acetate, cinchona.

Dose, $\frac{1}{2}$ to 2 gr. of the powdered leaves.

Preparations.

1. Infusum Digitalis.—Dried leaves, 60 grains; boiling water, 1 pint (contains much digitonin, not much digitoxin).

Dose, 2 to 4 fl. dr. (note that it is drachms, not ounces).

2. Tinctura Digitalis.—Dried leaves, $2\frac{1}{2}$; alcohol (60 per cent.), 20. Percolate. (Contains both digitalin and digitoxin.)

Dose, 5 to 15 m.

As the proportion of the many constituents varies in the preparations, some prefer always to give the powdered leaves.

Action.

External.—The leaves are slightly irritating, but it is doubtful whether any of their constituents can be absorbed by the skin.

Internal.—*Gastro-intestinal tract.*—Digitalis is a **mild gastro-intestinal irritant**, and even moderate doses cause vomiting and diarrhœa in some people.

Blood.—It is rapidly absorbed; it is not known to affect the blood.

Heart.—The first action of digitalis is to **slow the beat** of the heart, the **diastole is prolonged**, the duration of the systole is not altered, but its **force is greatly increased**, so much so that after large doses the heart may, in animals, be seen to become pale, because almost every drop of blood is squeezed out of it. The pulse is consequently increased in force, but retarded. If before the drug was given the heart was beating irregularly, it generally becomes regular. If a larger dose is given, it is observed that the intense systolic contraction is not uniform all over the organ. The auricles and ventricles do not beat synchronously; and even one portion—as the apex, for example—of the ventricle may remain spasmodically contracted during the diastole of the rest of the ventricle. This causes the heart to assume hourglass and other curious shapes. Finally it is arrested in systole, and is firmly contracted, quite pale, and unable to respond to any mechanical or electrical stimuli. This account is true for all animals, except that sometimes in dogs and men the heart finally stops in diastole.

That these phenomena are chiefly due to the **direct action** of the drug on the **cardiac muscle** is shown by the fact that digitalis not only acts when applied locally to the heart, but will even increase the force of the contraction when applied to the isolated apex in which it is believed no nerves exist, and it acts on the embryonic heart of the chick before the nerves are developed. But the inhibitory activity of the cardiac peripheral end of the vagus is increased; for a mild stimulation of the vagi, which, before the drug was given, had no effect, will, after the drug is given, stop the heart, and in warm-blooded animals digitalis does not very markedly retard the pulse if the vagi have been cut, although it increases the force of the cardiac beat. Possibly to a slight extent the vagus centre in the medulla is stimulated, but the main action of digitalis is to excite the cardiac muscle itself and the cardiac inhibitory terminations of the vagus. Digitalis has been thought to affect the ganglia of the heart, but there is no satisfactory evidence of this.

It has been proved that even small doses actually **increase the amount of work** done by the heart in a given time.

Vessels.—Moderate doses of digitalis produce a **great rise in the blood-pressure.** This is partly due to the greater cardiac force, but not entirely, for in the web of the frog's foot and the rabbit's mesentery the arterioles have been observed to contract vigorously when digitalis has been given. As this still occurs in arterioles quite separated from the body, and through which an artificial circulation of blood containing digitalis is carried on, it is clear that the drug contracts the arterioles by **direct action on their muscular coat.** But as the contraction is greater in an intact animal than in one whose spinal cord is destroyed, or in whom the nerves going to the part experimented upon are divided, it is clear that digitalis also **stimulates** the medullary and spinal **vaso-motor centres.** With toxic doses the irritation of the centres and of the muscular coat of the arterioles passes on to depression, and the blood-pressure falls.

Kidney.—The effect of digitalis on the kidney is very uncertain. Most experimenters have found that in health it is diuretic, but some have not, and the same discrepancy in its action on the kidney exists in patients with heart disease, but generally in these cases it is a **diuretic.** The reasons for these discrepancies are that if the arterial vessels are, like the rest of the vessels in the body, tightly contracted by the drug, very little blood will come to the kidney, and very little urine will be secreted; but if the digitalis does not constrict the renal vessels markedly, the increased cardiac force and the general rise of blood-pressure will send more blood through the kidney and more urine will be secreted. Some observers state that digitalin and digitoxin have a special effect in relaxing the vessels of the kidney. If this is so, the question is still more complicated, for then the diuretic influence of digitalis will depend largely upon the particular preparation which is given. The truth probably is that with a small dose of digitalis or in the first stage of a large one the vessels of the kidney, like those of the rest of the body, are contracted, and the flow of urine is diminished; but the renal arterioles, being the first in the body to suffer from the subsequent arterial relaxation, dilate while the general blood-pressure is still high, and then digitalis acts as a powerful diuretic.

We have no certain knowledge of the effect of digitalis on the constitution of the urine.

Temperature.—Moderate doses have no influence on the temperature, but toxic doses cause it to fall even in health. The reason of this is unknown.

Respiration.—This is unaffected by digitalis unless poisonous doses have been given, when it begins to fail from the imperfect circulation through the respiratory mechanism.

Nervous system and muscles.—Medicinal doses have no marked influence. Large doses will, because of the alterations in the cerebral circulation, cause headache, giddiness, and disturbances of sight and hearing. In many cases of poisoning all objects have appeared blue.

The reflex activity of the cord and motor nerves is depressed independently of the action on the circulation; sensory nerves are unaffected. Digitalis directly paralyses muscles if given in toxic doses.

Uterus.—This organ is said to be stimulated to contract by digitalis.

THERAPEUTICS.

External.—Digitalis is not used externally.

Internal.—It is one of the most valuable drugs we have. It is chiefly given in cases of cardiac disorder.

Mitral regurgitation.—If in any case of this variety of heart disease the organ is beating feebly, irregularly, and rapidly, digitalis in moderate doses will probably strengthen, regulate, and slow the beat. It will cause the left ventricle to contract more forcibly, and to act synchronously in all its parts; hence the mitral flaps will be better approximated, the regurgitation will be less, and more blood will be sent on into the arterial circulation. The prolonged diastole will also be of great advantage, for it will allow more time for the blood to flow from the dilated auricle, and from the right side of the heart and venous system generally, into the left ventricle. In mitral regurgitation, as is well known, venous engorgement and œdema of the lungs, of the right side of the heart, of the liver, the kidneys, and subcutaneous tissues are very common. Digitalis, by improving the venous flow towards the heart, will ameliorate all these symptoms. It might be supposed that by constricting all the peripheral arterioles it would impede the arterial flow because the heart will have to contract against a greater peripheral resistance, but this disadvantage is never enough to seriously hamper the increased cardiac power; and it must be remembered that it is a great advantage to the circulation to have a proper peripheral arterial resistance, for without that the elastic coat of the arteries cannot aid the arterial flow. If, as it usually does in these cases, digitalis acts as a diuretic, this will be of great value in removing the œdema, and in causing the scanty high-coloured urine to become pale and abundant. The improvement in the circulation relieves the cardiac pain and distress which so commonly accompany mitral regurgitation, the lividity passes off, the dyspnœa decreases, and usually in a day or two a wonderful improvement in the patient's condition takes place. The more any case of mitral regurgitation deviates from the above waterlogged type, the less good, as a rule, will digitalis do. Thus cases in which there is much pain and distress and but little regurgitation are not so often benefited, although even of such cases many are improved. Sometimes the vomiting caused by digitalis prohibits its use.

Mitral constriction.—In this condition it is obvious that it will be a great advantage to lengthen the diastole, for then there will be a greater chance that the diastole will be long enough to allow the normal amount of blood to pass through the constricted orifice. In proportion as this end is attained, the œdema, lividity, and other signs of backward venous congestion will be relieved. The increased force of the auricular contraction caused by digitalis will help in the same direction, and if it induces diuresis this is very valuable in aiding the reduction of the œdema.

Disease of the tricuspid valve.—In both tricuspid constriction and tricuspid regurgitation digitalis will be beneficial in the same way as in similar affections of the mitral valve. As a rule, however, it does less good when the disease is on the right side of the heart.

Aortic regurgitation.—Often digitalis is harmful, for by prolonging the diastole more time is allowed for the blood to fall back through the imperfectly closed aortic orifice, and hence there is great danger of fatal syncope. The drug should only be given in cases of aortic regurgitation when the heart is rapid, or when there is evidence that not much blood regurgitates, or when there are reasons, such as tho coincident presence of aortic obstruction, for wishing to strengthen and regulate the contraction. The dose must be small and the effects must be carefully watched.

Aortic obstruction. — This, unfortunately, is usually accompanied by aortic regurgitation; but sometimes when it is wished to increase the force of the beat, and so to drive more blood through the constricted aortic orifice, digitalis is useful, or when, as a result of the obstruction, mitral dilatation and consequent regurgitation, with much pulmonary and venous engorgement, have set in. Many cases of pure aortic obstruction do not require drugs, for the heart hypertrophies sufficiently to overcome the obstruction.

Bright's disease.—In cases of contracted granular kidney in which the cardiac hypertrophy has been unable to overcome the peripheral resistance, and consequently the left ventricle and with it the auriculo-ventricular orifice has dilated, and mitral regurgitation has therefore ensued, digitalis may be of service, for the reasons given on p. 384. A diuretic pill, often used for this condition, consists of mercurial pill, digitalis leaves, and squill, a grain of each, made up with extract of henbane. Otherwise in chronic Bright's disease digitalis is not a suitable diuretic, for it raises the tension of the pulse, which is already high. In the earlier stages of acute Bright's disease it has been given as a diuretic, but it is questionable whether it is right to dilate the vessels of an acutely inflamed organ; further, digitalis is always, unless the heart is diseased, an uncertain diuretic, and even in the early stages of acute Bright's disease the arterial tension is somewhat raised. In chronic tubal nephritis uncomplicated by cardiac disease it is worse than useless, for it has no effect on the renal cells, and it raises the blood-pressure.

Diseases of the cardiac muscle.—If the heart be fatty, digitalis may do good; but it is said that there is danger of rupture of some of the softened fatty fibres. The weakly acting heart that is met with after pericarditis, typhoid fever, scarlet fever, rheumatism, and other acute diseases, even if no valvular defects are present, is markedly strengthened by digitalis. Each contraction is more efficient, and the prolonged diastole allows more time for the muscle to rest. It is clear that in the course of twenty-four hours this additional repose, although but little in each cycle, will amount to a considerable time. Many men who have practised rowing or other hard exercise to excess suffer from shortness of breath, and the apex of the heart is found to be a little outside the normal position, but there is no demonstrable valvular lesion. This condition, which also occurs in soldiers after a long campaign, is much benefited by digitalis. The dilatation of the right side of the heart that so frequently accompanies chronic disease of the lungs may be, but is not usually, improved by digitalis.

Functional disease of the heart.—The irregular palpitating beat, often seen apart from any organic disease, may be benefited markedly by digitalis ; but it must be remembered that this condition is commonly a result of indigestion, in which case the right treatment is, if possible, to cure the dyspepsia, and if digitalis is given at all, to do so cautiously, for it may excite indigestion. The functional affections of the heart met with in highly neurotic subjects may be, but are not often, benefited by digitalis.

Exophthalmic goitre may improve under a long course of digitalis ; but generally this treatment fails.

Hæmorrhage.—Although digitalis contracts the arterioles it is not often given as a hæmostatic, for the increased blood-pressure may lead to greater hæmorrhage, but it may be useful in the pulmonary hæmorrhage due to disease of the mitral valve.

Alcoholism.—Moderate doses of digitalis have been said to be serviceable in chronic alcoholism on account of their stimulating effect on the circulation. Enormous doses have been given empirically in delirium tremens, but generally without any good result.

Uterus.—Because of its power to contract the uterus digitalis may be useful in menorrhagia.

It is often desirable to combine fluid preparations of digitalis with salts of iron, the resulting mixture, which is usually inky from the action of the iron on the tannin in the digitalis, can be clarified by the addition of a little dilute phosphoric acid. Because of this difficulty the powdered digitalis leaves are often made into a pill with dried sulphate of iron.

ANTAGONISMS.

Antagonism between *digitalis and aconite.*—Aconite is a cardiac poison, weakening instead of strengthening the beat; it dilates the peripheral vessels, it lowers the blood-pressure, and after death the heart is always found in a condition of diastole. In all these points it is antagonistic to digitalis. The action of aconite is very rapid, that of digitalis very slow. Therefore these drugs are not practical antidotes to each other in poisoning.

Scoparin is also physiologically antagonistic to digitalis.

Digitalis is **cumulative.** Patients who have taken it for a long while sometimes suddenly show symptoms of poisoning without any increase in the dose. This is because, as the drug is not excreted by the kidneys as fast as it is absorbed, it accumulates in the body.

STROPHANTHUS.

Strophanthi Semina.—The dried ripe seeds of *Strophanthus Kombé* (Nat. Ord. *Apocynaceæ*), freed from awns. Equatorial West Africa.

CHARACTERS.—Oval-acuminate, greenish fawn, covered with appressed silky hairs, $\frac{3}{5}$ in. long, $\frac{1}{6}$ in. broad, base blunt, apex tapering, sides flattened, one side has a ridge from centre to apex, dorsal surface convex. Kernel white and oily, consisting of a straight embryo with two thin cotyledons surrounded by their albumen. Odour characteristic. Taste very bitter.

COMPOSITION.—The chief constituents are—(1) *Strophanthin*, $C_{31}H_{48}O_{12}$. This is in all probability the same as, or very closely allied to, the active principle ouabaïne, which has also been isolated from strophanthus. It exists in all parts of the plant, but mostly in the seeds (8 to 10 per cent.). It is a transparent, white, crystalline, bitter glucoside (being split up by acids into glucose and strophanthidin). Insoluble in chloroform and ether, soluble in water. Ouabaïne is said to be less soluble than strophanthin. (2) Kombic acid. (3) Inein, an active principle.

Preparations.

1. **Extractum Strophanthi.**—Dried powdered strophanthus is percolated with ether, dried, percolated with alcohol, dried, and diluted with milk sugar.

Dose, $\frac{1}{4}$ to 1 gr.

2. Tinctura Strophanthi.—Dried strophanthus seeds, $\frac{1}{2}$; alcohol (70 per cent.), 20. Percolate.

This is made with half the strophanthus seeds of that of B. P. 1885 (Addendum 1890).

Dose, 5 to 15 m.

ACTION.

External.—None.

Internal.—*Gastro-intestinal tract.*—Like digitalis, strophanthus is liable to cause **vomiting and diarrhœa,** especially if the dose be large. In small doses its bitter action may come into play, and then it will aid digestion like any other bitter stomachic.

Heart.—Strophanthus acts on the **heart exactly like digitalis,** for it strengthens the force without altering the duration of the systole, slows the rate of the beat, and consequently prolongs the diastole, and makes an irregular heart regular. In fatal cases of poisoning by strophanthus the heart may be arrested either in diastole or systole. The details of its cardiac action are the same as those of digitalis.

Vessels.—It does **not constrict the peripheral vessels,** or at any rate very slightly; therefore, the slow rise of blood-pressure is almost entirely due to the action of the drug on the heart. This is the most important difference between it and digitalis, which contracts the vessels powerfully, and consequently gives a greater rise of blood-pressure.

Kidneys.—It is diuretic, but not nearly so powerfully as digitalis. Probably the diuresis is entirely due to the increased cardiac action. No special alteration in the size of the renal vessels takes place under strophanthus.

Nervous system.—This is not affected. In toxic doses it is a direct poison to the voluntary muscles. Both strophanthin and ouabaïne are powerful local anæsthetics when dropped on the conjunctivæ.

Respiration.—No particular effect is produced. The African Kombé arrow poison is made from strophanthus.

THERAPEUTICS.

Strophanthus is used in the same varieties of cardiac disease as digitalis: that is to say, when it is desirable to slow the heart, to increase its force, to make it regular, and to prolong the diastole. It is clear, therefore, that it will be chiefly valuable in cases of mitral disease. *A priori*, it might be thought that as strophanthus does not contract the peripheral vessels and so increase the cardiac resistance, consequently it would be the more useful drug; but experience has not confirmed this, and therefore, in the treatment of a case of heart disease, digitalis should be used first; but if the patient does not improve on this, then strophanthus may be tried. It will sometimes happen that strophanthus will not produce vomiting when digitalis does, but there are many individual differences. Digitalis should be given whenever a diuretic effect is desired; but strophanthus, as it does not constrict the peripheral vessels, is preferable when it is wished to give one of these drugs to a patient suffering from chronic Bright's disease. Strophanthus is not cumulative. It has been recommended in exophthalmic goitre.

Ouabaïne has been given in whooping-cough.

SQUILL.

Scilla.—Squill. The bulb of *Urginea scilla* (Nat. Ord. *Liliaceæ*), divested of its dry, membranous, outer scales, cut into slices and dried. Mediterranean coast.

CHARACTERS.—The slices of the inner scales are curved, yellowish-white or pinkish, translucent strips, 1 to 2 in. long. Odour none. Taste very bitter. Easily pulverizable if dry, not if wet.

COMPOSITION.—The chief constituents are—(1) *Scillitoxin*, the most active principle. (2) Scillipicin, also active, and closely related to scillitoxin. (3) Scillain or scillin, a bitter, non-nitrogenous glucoside. (4) Mucilage.

Dose, 1 to 3 gr.

Preparations.

1. **Acetum Scillæ.**—Squill, 1; Dilute acetic acid, 8. Macerate.
Dose, 10 to 30 m.

2. **Oxymel Scillæ.**—Digest Squill, 2½ oz., with acetic acid, 2½ fl. oz., and water, 8 fl. oz., for 7 days. Press and filter, and mix the filtrate with liquid clarified honey, 27 fl. oz.
Dose, ½ to 1 fl. dr.

3. **Syrupus Scillæ.**—Acetum Scillæ, 1; sugar, 2.
Dose, ½ to 1 fl. dr.

4. **Pilula Ipecacuanhæ cum Scillâ.**—Squill, 1; compound ipecacuanha powder, 3; ammoniacum, 1; syrup of glucose, q. s. (*see* Opium, p. 312). 1 in 20
Dose, 4 to 8 gr.

5. **Pilula Scillæ Composita.**—Squill, 1¼; ginger, 1; ammoniacum, 1; hard soap, 1; syrup of glucose, 1.
Dose, 4 to 8 gr.

6. **Tinctura Scillæ.**—Squill, 1; alcohol (60 per cent.), 5. Macerate.
Dose, 5 to 15 m.

ACTION.

Squill so closely **resembles digitalis** in its action that the account of that drug will apply to squill with the following additions. Squill is a much **more powerful gastro-intestinal irritant**; vomiting and purging result from even moderate doses, and after death, if animals are killed with it, much gastro-enteritis is found. In the second place, some constituent of squill is excreted by the bronchial mucous membrane, and in passing through it irritates it. The vascularity and the amount of secretion are thereby increased. Squill is, therefore, a powerful **expectorant.** Thirdly, squill in the course of its excretion through the kidneys stimulates them; it is, therefore, a **more energetic diuretic** than digitalis, and it may irritate the kidneys excessively.

THERAPEUTICS.

Because of its irritating properties squill is not given alone, but it is frequently combined with digitalis when that drug is administered for heart disease or as a diuretic. A very favourite diuretic pill is composed of powdered squill, powdered digitalis leaves and blue pill, 1 grain of each, made up with some simple vehicle.

Squill is much used as an expectorant. Here also it is always prescribed in combination; it is too irritating to the bronchial mucous membrane for it to be advisable to give it in acute bronchitis; nor should it be chosen in phthisis, lest it should cause dyspepsia; but it is valuable in chronic bronchitis if the secretion is scanty.

Squill should not be given in acute Bright's disease, for it is too irritating to the kidneys.

Convallaria Majalis.—(Not official.)

The lily of the valley (Nat. Ord. *Liliaceæ*). The entire plant is used.

CHARACTERS.—Leaves 4 to 6 in. long, radical, oblong, tapering. Flower stem leafless, radical, shorter than the leaves. Flowers white, bell-shaped, drooping, forming a loose raceme.

COMPOSITION.—The chief constituents are—(1) Convallamarin, a glucoside, the active principle. (2) Convallarin, a glucoside, said only to purge.

Preparations (Brit. Pharm. Conference).

1. Extractum Convallariæ.—Aqueous of the whole flowering plant.

Dose, 2 to 8 gr.

2. Tinctura Convallariæ. — The flowers, 1; alcohol (70 per cent.), 8.

Dose, 5 to 20 m.

ACTION AND THERAPEUTICS.

The action of Convallaria Majalis is precisely that of digitalis, and it may be given in exactly the same varieties of heart disease. It is sometimes successful when digitalis has failed. It is not so powerful as digitalis, but some find it less likely to produce sickness.

Erythrophlœum.—(Not official).

Casca Bark.—*Synonyms.*—Sassy bark; Ordeal bark. The bark of *Erythrophlœum guineense* (Nat. Ord. *Leguminosæ*). Africa.

COMPOSITION.—The active principle is erythrophlœine, an alkaloid.

Preparation (Brit. Pharm. Conference).

Tinctura Erythrophlœi.—Sassy bark, 1; alcohol (90 per cent.), 10.

Dose, 5 to 10 m.

ACTION AND THERAPEUTICS.

The action of erythrophlœum is the same as that of digitalis, and it may be used for the same class of cases. It is, however, more likely to cause vomiting.

CLASS II.—**The Aconite Group.**

ACONITE.

Aconiti Radix.—Aconite Root. The dried root of *Aconitum napellus*, collected, in the autumn, from plants cultivated in Britain.

CHARACTERS.—Usually 2 to 4 in. long. Upper extremity, crowned with base of stem, is ½ to ¾ in. in diameter; conical, shrivelled, shows bases of broken rootlets; dark brown externally, whitish internally. Has a central axis with rays. Cautiously chewed, produces after some minutes tingling an numbness. Resembles horseradish (*see* p. 481).

COMPOSITION.—The active principle is the alkaloid *aconitine*, *see* p. 395. Other alkaloids are aconine, isaconitine (paraconine) and another unnamed.

Preparations.

1. Linimentum Aconiti.—Powdered root, 20; camphor, 1; alcohol (90 per cent.), to make 30.

2. Tinctura Aconiti.—Powdered root, 1; alcohol (70 per cent.), 20. Percolate.

Dose, 5 to 15 m., or if very frequently repeated, **2 to 5 m.**

This is made with two-fifths of the aconite root, B. P. 1885.

Aconitina.—Aconitine. $C_{33}H_{45}NO_{12}$.

SOURCE.—An alkaloid obtained from aconite root.

CHARACTERS.—Colourless, hexagonal prisms of the rhombic system. Melting point, 372–374° F. Produces tingling when placed on tongue. Its salts are crystalline. Its solutions acidulated with acetic acid give a red crystalline precipitate on addition of potassium permanganate. When heated it takes up a molecule of water, and forms aconine and benzoic acid. *Solubility.*—Readily in alcohol and chloroform, less so in ether; nearly insoluble in water.

Preparation.

Unguentum Aconitinæ.—Aconitine, 1 gr.; oleic acid, 8 gr.; lard, 41 gr.

ACTION.

External.—Applied to the skin, to a mucous membrane, or to a raw surface, aconite or its alkaloid first stimulates and then paralyses the nerves of touch and temperature; it therefore causes first **tingling**, then **numbness and local anæsthesia**, which last some time.

Internal.—*Gastro-intestinal tract.*—Unless it is very dilute, numbness and tingling are produced in the mouth. There are no other gastro-intestinal symptoms unless the dose is very large, when there may be vomiting.

Heart.—The rate of the beat may be at first a little increased by aconite, but soon the pulse is very decidedly **slowed**, shortly after that the **force and tension** become less. Finally the heart is arrested in diastole. It is certain that towards the end of its action aconite influences the heart itself, for it will retard the excised organ when applied directly to it. It is extremely probable that in the earlier stages the drug acts upon the cardiac nerves or their centres; but the details of such action are not known. The effect on the heart leads to a **fall of blood-pressure**, but whether this is partly due to an action on the vaso-motor system itself is undecided.

Respiration.—The rate of respiration is **slowed**, expiration and the pause after it are considerably prolonged. This is chiefly due to the action of aconite on the centre in the medulla, but in part to the paralysis of the peripheral endings of the afferent vagal fibres.

Nervous system.—The evidence is very conflicting, but it appears clear that aconite, whether given internally or applied locally, **depresses** the activity of the peripheral **terminations** of the nerves; the **nerves of common sensation and temperature** are affected before the motor. Any **pain** that may be present is **relieved.** Large doses in man cause clonic convulsions. Later on the paralysis of the motor nerves gives rise to muscular weakness. It is doubtful whether the cord is influenced. The brain is not. The pupil is first contracted, then dilated.

Temperature.—Aconite causes a febrile temperature to **fall.** The cause of this is not known.

Skin.—Aconite is a mild **diaphoretic**; in this case also we do not understand how it acts. Occasionally it produces an erythematous rash.

Kidneys.—It is said to be a feeble diuretic, but its effect is very slight. We do not know the channel by which it is eliminated.

THERAPEUTICS.

External.—As aconite produces local anæsthesia, it is applied externally and often with great benefit in cases of neuralgia, especially facial neuralgia. Frequently it fails, and we cannot tell beforehand whether it will succeed. A small piece of the ointment may be rubbed in till numbness is produced, but as this is a very expensive preparation it is usually better to paint on the liniment with a camel's-hair brush. The pain of chronic rheumatism is sometimes relieved by aconite.

Internal.—It may be given internally for neuralgia, but it does not succeed nearly so well as when applied externally. It is not used internally so much as formerly, when it was administered in almost every febrile disease, with the object of decreasing the force and tension of the pulse. Certainly it does this very effectually, and the only reason why it is not so popular at the present time is that it is not now thought desirable to reduce the force and frequency of the heart in these diseases. Perhaps it is used too little, for many believe that the milder febrile diseases, such as tonsillitis, laryngitis, or a common cold, are distinctly benefited by aconite. In addition to retarding the pulse it increases perspiration and lowers the temperature. As large doses diminish the force of the heart, it is usually given in doses of two or three minims of the tincture every hour or so till the pulse falls to nearly normal; for the same reason it is not advisable to use it for prolonged fevers, as typhoid, nor when the heart is diseased, except in the few cases in which there is sufficient compensative cardiac hypertrophy. In such cardiac cases it is sometimes useful to slow the pulse, even when there is no fever. It will occasionally relieve the pain of aneurysm. A common practice was to combine with it one or two drops of Vinum Antimoniale, as that has much the same action on the heart. Formerly it was much used in surgery if it was feared that inflammation might set in after injuries.

Toxicology.

The symptoms come on quickly; in a few minutes there is a severe burning, tingling sensation in the mouth, followed by numbness. Vomiting begins in an hour or so, and is very severe. There is an intense abdominal burning sensation. The skin is cold and clammy. Numbness and tingling with a sense of formication of the whole skin trouble the patient very much. The pupils are dilated, the eyes fixed and staring. The muscles become very feeble, hence he staggers. The pulse is small, weak, and irregular. There is difficulty of respiration. Death takes place from asphyxia, or in some cases from syncope. He is often conscious to the last. *Post mortem.*—The usual signs of death from asphyxia are seen.

Treatment.—Wash out the stomach promptly, give emetics (p.129). Inject stimulants, as ether or brandy, subcutaneously; apply warmth. Atropine and the tincture of digitalis should be given subcutaneously.

Amyl Colloid.—(Not official.)

Synonym.—Anodyne colloid. The composition of this is amyl hydride, 1 fl. oz.; aconitine, 1 gr.; veratrine, 6 gr.; collodion to 2 fl. oz.

Action and Therapeutics.

Amyl colloid is painted on the skin over painful areas in neuralgia, sciatica, &c. It is an elegant method of obtaining the local anæsthetic action of aconitine and veratrine, which is aided by the evaporation of the hydride of amyl; and when the collodion has formed a film, a piece of warm moist spongiopiline helps the anæsthetic effect of the alkaloids.

VERATRINE.

Veratrina.—Veratrine, an alkaloid or mixture of alkaloids obtained from cevadilla, the dried ripe seeds of *Schœnocaulon officinale* (Nat. Ord. *Liliaceæ*). It usually consists of veratrine and slight admixtures of two other alkaloids, cevadine and cevadilline.

Source.—Prepared from cevadilla by precipitation with ammonia.

Characters.—A pale grey amorphous powder. Odour none, but very irritating to the nostrils. Taste very bitter and acrid. *Solubility.*—1 in 6 of ether; 1 in 3 of alcohol (90 per cent.); readily in dilute acids; very feebly in water.

Dose, $\frac{1}{70}$ to $\frac{1}{16}$ gr. in pill.

Pure veratrine, $C_{37}H_{53}NO_{11}$, crystallizes in rhombic prisms. The pharmacopœial veratrine is very rarely pure veratrine.

Preparation.

Unguentum Veratrinæ.—Veratrine, 1 gr.; oleic acid, 4 gr.; lard, 45 gr.

ACTION.

External.—Veratrine has no effect when applied to the unbroken skin, but it is a powerful **irritant** when rubbed in; it then causes a feeling of warmth, followed by pricking, severe pain, and finally **numbness.** There is at the same time considerable hyperæmia.

Internal.—*Gastro-intestinal tract.*—Its irritant action is even more marked on mucous membranes than on the skin. Inhalation of the minutest portion causes great irritation of the mucous membrane of the nose, violent **sneezing**, and a free **discharge of mucus**, which may be bloody. A speck on the tongue gives rise to burning pain and profuse **salivation.** On arriving at the stomach and intestine it produces great **epigastric pain, vomiting, and diarrhœa.**

Blood.—Veratrine is quickly absorbed. It is not known to affect the living blood, but it kills the white corpuscles in drawn blood.

Heart.—It acts directly on the cardiac muscle as it does upon voluntary muscle: that is to say, the **contractions** of the heart become **fewer**, but each **lasts a very long while** until ultimately the heart stops in systole. It also acts on the **vagus** as on spinal nerves, the functional activity being **first exalted**, and this is partly the reason of the slowing of the heart; afterwards the vagus is depressed, but this does not cause a quickening of the pulse, because of the action of the veratrine on the cardiac muscle, but it may make the beat irregular. The blood-pressure at first rises from the increased force of the beat, but when the heart becomes very slow it falls. Possibly these effects are also in part owing to the action of the drug on the vaso-motor centres.

Respiration.—Small doses quicken respiration, large ones retard it, producing long pauses, and finally **arresting** it. These results are probably due at first to stimulation, and afterwards to paralysis of the ends of the vagus in the lung, and to paralysis of the respiratory centres. The temperature is lowered.

Nervous system.—The brain is unaffected, and probably veratrine has no influence on the spinal cord. **Motor nerves** are **first excited** and then **paralysed,** and the **same is true of sensory nerves** and their endings, but here the primary stimulation is very marked, hence the transient pain produced by the local inunction of veratrine.

Muscles.—The effect of veratrine is peculiar and characteristic. In animals to which it has been given, or in excised muscles to which it is applied, it is found that the period during which a single **contraction** lasts is **enormously prolonged.** If a tracing of the contraction be taken it will be seen that the latent period and the time of the ascent of the curve are unaltered, that the height is greatly increased and the descent is extraordinarily extended. This is a genuine lengthened contraction, which is neither rigor nor tetanus, but it almost exactly resembles the contraction of the muscles met with in Thomsen's disease. This effect of veratrine disappears if the muscle is cooled.

THERAPEUTICS.

External.—Veratrine has been much used as an inunction for neuralgia, and sometimes it succeeds admirably, generally in the same class of cases as are benefited by the local application of aconite.

Internal.—It is rarely given internally, as it has such a powerful and peculiar action on the heart.

GROUP III.

Vegetable Drugs employed for their Action on the Respiratory Organs, and not falling among Volatile Oils (q.v.).

Senega, Ipecacuanha, Lobelia, Virginia Prune.

The first three are gastro-intestinal irritants. Senega and ipecacuanha are both excreted by the bronchial mucous membrane, which they irritate. Group II is connected with this group by senega, which acts on the heart like squill, and like it is excreted by the bronchial mucous membrane.

SENEGA.

Senegæ Radix.—The dried root of *Polygala senega* (Nat. Ord. *Polygaleæ*). From North America.

Characters.—Slender roots 2 to 4 in. long, of which the upper end is an irregular knotty tuberosity with remains of small stems, tapering below into a tortuous wrinkled keeled root, $\frac{1}{5}$ to $\frac{1}{2}$ in. thick. Bark yellowish or brownish grey, transversely cracked. Fracture short and brittle. Odour of bark peculiar and rancid, its taste at first sweetish, but afterwards very sour, and causing a flow of saliva. Central column woody, tasteless, and inodorous. *Resembling senega root.*—Arnica, Valerian, Serpentary, and Green Hellebore, but none of these have a keel.

Composition.—The chief constituents are—(1) Senegin, a glucoside, is the active principle, it is closely allied to and perhaps identical with Saponin, $C_{32}H_{54}O_{18}$, found in Saponaria (Quillaia bark, q. v.), and many other plants. Saponin is decomposed by hydrochloric acid into sugar and sapogenin. It exists as a white powder, which forms a soapy emulsion when mixed with boiling water. It acts like digitonin. (2) Polygalic acid.

Impurities.—Other roots are mixed with it.

Preparations.

1. Infusum Senegæ.—Senega root powdered, 1; boiling water, 20.

Dose, $\frac{1}{2}$ to 1 fl. oz.

2. Liquor Senegæ Concentratus.—Percolated in the usual way for concentrated liquors (*see* p. 18).

Dose, ½ to 1 fl. dr.

3. Tinctura Senegæ.—1 to 5 of alcohol (60 per cent.). Percolate.

Dose, ½ to 1 fl. dr.

ACTION.

External.—Senega is an **irritant** to the skin.

Internal.—*Alimentary canal.*—Senega in large doses is an **irritant** here also, producing salivation, vomiting, and diarrhœa. Even small doses often cause indigestion. It is absorbed with difficulty.

Circulation.—Senegin circulates as such in the blood. It affects the **heart like digitalis**, but not so certainly. It is excreted by the skin, the bronchial mucous membrane, and the kidneys.

Respiration.—When the powdered root is inhaled it acts as a violent irritant to the nose, causing much **sneezing** and cough, together with hyperæmia and increased secretion from the respiratory mucous membrane. If senega is taken internally, the bronchial mucous membrane is irritated because of the excretion through it of senegin, which causes vascular dilatation, greater secretion, and, reflexly, cough. Senega is therefore a **stimulating expectorant.**

Kidneys.—It is a diuretic, because the excretion of senegin through the kidneys causes irritation of them.

THERAPEUTICS.

Senega is only used as a stimulating expectorant. It is evident that it will be useful in bronchitis, when the secretion is scanty, and when the power to cough is feeble. As it is an irritant to the bronchial mucous membrane, it must not be given in acute bronchitis, nor on account of its gastro-intestinal action, when there is indigestion. It has been employed as a diuretic, but it is not powerful, and is uncertain.

IPECACUANHA.

Ipecacuanhæ Radix.—The dried root of *Psychotria ipecacuanha* (Nat. Ord. *Rubiaceæ*). Brazil.

CHARACTERS.—Twisted pieces 2 to 6 in. long, ¼ in. diameter. Cortical portion thick, dark red or brown, annulated, with a short, resinous waxy fracture. Central portion whitish, woody axis. Taste acrid, bitter. Odour slight, peculiar.

COMPOSITION.—The chief constituents are—(1) *Emetine*, 1·6 to 2·8 per cent., $C_{20}H_{30}NO_5$. An amorphous alkaloid and the active principle. It is white (turns yellow on keeping), odourless, bitter, feebly soluble, but forms soluble unstable salts. (2) Ipecacuanhic or cephaëlic acid. (3) A glucoside. (4) Tannin, volatile oil, starch, gum, &c.

IMPURITIES.—Hemidesmus, which is cracked, not annulated. Almond powder, occasionally found mixed with powdered ipecacuanha root, gives odour of prussic acid when moistened.

Dose of powdered root, ¼ to 2 gr. (expectorant), **15 to 30 gr.** (emetic).

Preparations.

1. Extractum Ipecacuanhæ Liquidum. — Powdered ipecacuanha, 1 pound; calcium hydroxide, 700 gr.; percolate with alcohol (90 per cent.), q. s. *Standardized to contain* 2·0 *to* 2·25 *per cent. of the alkaloids of the root.*

Dose, ½ to 2 m. (expectorant); **15 to 20 m.** (emetic).

2. Acetum Ipecacuanhæ.—Liquid extract of ipecacuanha, 1; alcohol (90 per cent.), 2; dilute acetic acid, 17. *Strength.*—0·1 per cent. of total alkaloids.

Dose, 10 to 30 m.

3. Vinum Ipecacuhanæ.—Liquid extract of ipecacuanha, 1; sherry, 19. *Strength.*—0·1 per cent. of total alkaloids.

Dose, 10 to 30 m. (expectorant); **4 to 6 fl. dr.** emetic).

4. Pulvis Ipecacuanhæ Compositus.—*Synonym.*—Dover's powder. Ipecacuanha, 1; opium, 1; sulphate of potassium, 8 (*see* Opium, p. 311). 1-10

Dose, 5 to 15 gr.

5. Pilula Ipecacuanhæ cum Scillâ.—Compound ipecacuanha powder, 3; squill, 1; ammoniacum, 1; syrup of glucose, q. s. (*see* Opium, p. 312). 1-20

Dose, 4 to 8 gr.

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6. Trochiscus Ipecacuanhæ.—$\frac{1}{4}$ gr. of ipecacuanha in each; made with a fruit basis.

7. Trochiscus Morphinæ et Ipecacuanhæ.—Ipecacuanha, $\frac{1}{12}$ gr.; morphine hydrochloride, $\frac{1}{36}$ gr. in each (see Morphine, p. 314); made with a tolu basis.

Action.

External.—Ipecacuanha powder is a powerful **irritant** to the skin, producing redness, vesication, and pustulation. It has some **antiseptic** powers, for it can destroy anthrax bacilli, but it has no effect on the spores. This property is not due to its emetine, but to some other constituent.

Internal.—*Alimentary canal.*—Here also the irritating action of ipecacuanha is seen. It increases the flow of saliva, dilates the gastric vessels, and stimulates the secretion of gastric juice. Therefore **small doses** are distinctly **stomachic**, and aid digestion. Large doses are, however, powerfully **emetic.** This is partly due to their irritant effect upon the stomach, but still more to the fact that emetine acts directly upon the vomiting centre in the medulla, as can be proved by observing that when the alkaloid is thrown directly into the circulation vomiting follows before there is time for it to have been excreted into the stomach. Ipecacuanha is therefore both a direct and indirect emetic. It produces a certain amount of depression, but not more than the mere act of vomiting will explain. It does not usually cause nausea. The irritant effect is continued in the intestine, and hyperæmia, excessive secretion, and purging result. In dysentery there is a peculiar tolerance of ipecacuanha. Ipecacuanha increases the amount of bile secreted, and is therefore a direct **cholagogue.**

Circulation.—No specific effect whatever is produced except by enormous doses which may arrest the beat of the heart, but the act of vomiting is somewhat depressing.

Respiration.—This likewise is unaffected. Ipecacuanha powder when inhaled, or ipecacuanha taken internally, when it is excreted by the bronchial mucous membrane, causes hyperæmia of it, together with an increased secretion of bronchial mucus, and therefore, reflexly, coughing is stimulated. It is consequently an **expectorant**; and because the nausea it induces depresses the circulation a little it is called a depressant expectorant, but this is a complete misnomer, considering that the bronchial mucous membrane is stimulated. Animals to which large doses of ipecacuanha or of emetine have been given show after death considerable hyperæmia of the bronchial mucous membrane, of the lungs, and of the stomach and intestines and the same condition of the respiratory passages is seen if ipecacuanha powder has been inhaled.

Skin.—Ipecacuanha is a mild **diaphoretic.**

THERAPEUTICS.

External.—Ipecacuanha is never at the present day employed for its external irritant effect. It has been used with success, as an antiseptic, in cases of anthrax. It is directed that the wound should be dressed with the powdered root, and that 5 grains should be taken by the mouth every four hours.

Internal.—*Stomach.*—Occasionally in small doses, such as 4 or 5 minims of the vinum or $\frac{1}{4}$ gr. of the powdered root, it is employed as a stomachic, and these quantities may even stop vomiting when other drugs have failed. A usual prescription to arrest the vomiting of pregnancy is a minim of ipecacuanha wine in water every half-hour. The compound powder has been praised in cases of gastric ulcer; probably any good effect it may have is due to its stimulating power. Ipecacuanha is a very common emetic. It should not be given when it is desired, as in cases of poisoning, to empty the stomach quickly, for some time elapses before it is absorbed and influences the medulla; nor should it be given to the very feeble, for it has no action that will counteract the depression of the vomiting. But it is an excellent emetic when it is wished, by the act of vomiting, to empty the air-passages, as in bronchitis, the early stages of diphtheria, tracheitis, and laryngitis, for not only the vomiting but the effect of the ipecacuanha on the respiratory tract and the slight subsequent depression will be beneficial. It is chiefly employed for this purpose in children, as they cannot cough well, and often it seems to act like a charm. It used to be given in the early stage of fevers, to empty the stomach of undigested food. A good emetic powder consists of, for an adult, 20 grains of powdered ipecacuanha with $\frac{1}{2}$ gr. of tartarated antimony.

Ipecacuanha is stated to be a specific for dysentery. How it acts is not known. Very large doses must be given—60 to 90 grains of the powdered root in a single dose, or 20 grains every four hours. Ipecacuanha from which the emetine has been removed (de-emetized ipecacuanha) has been much employed (dose, 10 to 30 gr.); on the other hand, it has been stated that the efficient agent in the treatment of dysentery is the emetine.

Half a grain to a grain or more is often combined in a pill with other cholagogues to relieve cases of hepatic dyspepsia, and sometimes with excellent results.

Respiration.—Ipecacuanha is a very common expectorant. Lozenges may be sucked, or the acetum or vinum may be given internally. It is suitable in cases of bronchitis or phthisis in which the secretion is scanty, and therefore there is much purposeless cough; and also when the disease is long-standing, for then the stimulation of the chronically inflamed mucous membrane will aid the cure of it. Its power of exciting the act of coughing adds to its usefulness.

The inhalation of ipecacuanha powder by means of an atomizer has been recommended in cases of asthma, and for the asthma-like paroxysms which often accompany chronic bronchitis. Sometimes it does good, but it may make the trouble worse.

Skin.—Dover's powder is very commonly used as a diaphoretic in mild feverish attacks.

LOBELIA.

Lobelia.—The dried flowering herb of *Lobelia inflata* (Nat. Ord. *Lobeliaceæ*). North America.

CHARACTERS.—The stems are angular, channelled and with narrow wings. Purple, scarred, hairy. Capsules inflated, two celled, containing minute oblong reticulated brown seeds. Odour irritating. Taste first mild, then burning and acrid when chewed.

COMPOSITION.—The chief constituents are—(1) *Lobeline*, a liquid volatile oily alkaloid, 30 per cent. Taste pungent. Odour like tobacco. It is combined with (2) lobelic acid, and forms crystallizable salts. (3) Lobelacrin.

INCOMPATIBLES.—Caustic alkalies, as they decompose lobeline.

Preparation.

Tinctura Lobeliæ Ætherea.—Lobelia, 1; spirit of ether, 5. Percolate.

This is made with about 1½ times the amount of lobelia used to make the tincture B. P. 1885.

Dose, 5 to 15 m.

ACTION.

External.—Lobelia has no effect on the skin, but it is stated that poisonous symptoms may occur from absorption of it through the epidermis.

Internal.—*Gastro-intestinal tract.*—Moderate or large doses are powerfully **irritant**, and thus they cause violent vomiting and purging. A peculiarity of the action of lobelia is that these results are accompanied by very intense **prostration**, as shown by the feeble pulse, cold sweats, pale skin, and great muscular relaxation.

Circulation.—In the frog the heart is at first stimulated, but soon depressed, and it finally stops in diastole. The blood-pressure falls. This is due partly to the action on the heart, and partly to paralysis of the vaso-motor centres.

Respiration.—Small doses slow respiration; large doses strongly depress the respiratory centre, and death takes place from respiratory failure. The muscular coat of the bronchi is said to be **relaxed.**

Nervous system.—Toxic doses are required to affect the higher cerebral centres, and then coma and convulsions are produced, but it is not clear how far these results are due to asphyxia. The respiratory and vaso-motor centres, and probably the cardiac, are, as already mentioned, depressed. Experiments seem to show that the motor centres of the cord are also depressed. Muscles and nerves are unaffected.

Lobeline is probably excreted by the kidneys and skin, and is said to have diuretic and diaphoretic properties.

THERAPEUTICS.

Lobelia has been recommended as a purgative and as an emetic, but it should not be used for these purposes, because of its great liability to produce collapse. It is employed in asthma to relax the muscular coat of the bronchial tubes. A teaspoonful of the tincture should be given till nausea is experienced, but it should never be pushed beyond that point. It may also be prescribed for bronchitis accompanied by spasmodic dyspnœa.

VIRGINIAN PRUNE BARK.

Pruni Virginianæ Cortex.—The bark of *Prunus serotina* (Nat. Ord. *Rosaceæ*) collected in the autumn.

Characters.—Curved pieces or fragments about $\frac{1}{12}$ inch thick. Young bark frequently smooth and reddish, with transversely elongated lenticels and short granular fracture; old bark is brown and rough. Taste, astringent and bitter. Odour after maceration with water like bitter almonds.

Composition.—It contains (1) Amygdalin, which yields with water glucose, hydrocyanic acid and essential oil of bitter almonds (*see* p. 539). (2) Emulsin.

Preparations.

1. Syrupus Pruni Virginianæ.—Virginian prune bark, 3 oz.; refined sugar, 15 oz.; glycerin, $1\frac{1}{4}$ fl. oz.; water to 20 fl. oz. Percolate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

2. Tinctura Pruni Virginianæ.—Virginian prune bark, 4 oz.; alcohol (90 per cent.), $12\frac{1}{2}$ fl. oz.; distilled water, $7\frac{1}{2}$ fl. oz. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Action and Therapeutics.

When this drug is treated with water, hydrocyanic acid is formed, and that is probably the reason why it is efficacious in relieving cough, especially a hacking cough, by which nothing is expectorated, for prussic acid diminishes reflex excitability. Virginian prune is a very favourite remedy, and the syrup is a very useful flavouring agent for cough mixtures.

GROUP IV.

Vegetable Drugs having Antiperiodic, Antipyretic, and Antiseptic Properties.

Cinchona Bark, Quinine, Salicin, Salicylic Acid, Hydrastis.

CINCHONA BARK.

Cinchonæ Rubræ Cortex.—Red Cinchona Bark. The dried bark of the stem and branches of cultivated plants of *Cinchona succirubra* (Nat. Ord. *Rubiaceæ*). South America and India.

Characters.—Quills or incurved pieces, a few inches to a foot long, $\frac{1}{10}$ to $\frac{1}{4}$ in. thick, coated with periderm. Outer surface rough from longitudinal furrows, ridges, transverse cracks, annular fissures, and warts, brownish or reddish brown. Inner surface brick-red or deep reddish brown, irregularly and coarsely striated. Fracture nearly close in the smaller quills, finely fibrous in the larger. Powder brown or reddish brown. No odour. Taste bitter and astringent.

Composition.—The chief constituents of cinchona bark are five alkaloids, two acids, a glucoside, tannin, a colouring matter, and a volatile oil.

(1) *Quinine.*—An alkaloid. $C_{20}H_{24}N_2O_2$. Exists as the hydrate. White acicular crystals, inodorous, very bitter. Gives a green colour with chlorine water and ammonia; turns the plane of polarization to the left; solutions of its salts are fluorescent. Soluble in ether and in ammonia. Forms salts with acids. (*See* Sulphate and Hydrochloride, pp. 412 and 413.)

(2) *Quinidine.*—An alkaloid. $C_{20}H_{24}N_2O_2$. Isomeric with quinine, differing from it only in crystallizing in prisms, turning the plane of polarization to the right, and not being soluble in ammonia except in excess.

(3) *Cinchonine.*—An alkaloid. $C_{20}H_{24}N_2O$. Colourless prisms, inodorous, bitter. No green colour with chlorine water and ammonia. Turns the plane of polarization to the right. Not fluorescent. Almost insoluble in ether and in ammonia.

(4) *Cinchonidine.*—An alkaloid. $C_{20}H_{24}N_2O$. Isomeric with cinchonine, differing from it in turning the plane of polarization to the left, being sparingly soluble in ether, and being slightly fluorescent.

Good red bark should yield 5 to 6 per cent. alkaloids, not less than half being quinine and cinchonidine. Of non-official cinchona barks, good yellow bark should yield 2·5 to 3·5 per cent. of quinine, and pale bark, very little quinine, but 0·7 to 1·4 total alkaloids, chiefly cinchonine and quinidine.

(5) *Conquinamine.*—An alkaloid. Not important.

(6) *Chinic or quinic acid.*—$C_7H_{12}O_6$. Large colourless prisms. It and its salts are soluble in water, and thus quinine may be given subcutaneously as quinate of quinine. This acid is found in the coffee bean and other plants. It is allied to benzoic acid, and appears in the urine as hippuric acid.

(7) *Chinovic acid.*—A white amorphous substance related to chinovin.

(8) *Chinovin.*—A glucoside, which easily decomposes into glucose and chinovic acid.

(9) *Cincho-tannic acid.*—1 to 3 per cent. It is the astringent principle of cinchona bark. It differs from tannic acid in striking green with per-salts of iron. It is easily oxidized to cinchona red.

(10) *Cinchona red.*—The colouring matter of the bark. It is almost insoluble in water.

(11) *A volatile oil.*—This exists in minute quantities. Cinchona bark owes its smell to it.

Remijia bark (from which quinine may be prepared) yields in addition homoquinine, which yields quinine and another alkaloid, cupreine.

Impurities.—Inferior barks, known by their not yielding the full strength of quinine and cinchonidine.

Incompatibles.—Ammonia, lime water, metallic salts, and gelatin.

The Pharmacopœia directs that the official bark, when used to make the preparations of it, should contain between **5 and 6 per cent.** of total alkaloids, of which not less than half consists of quinine and cinchonidine.

Dose, 3 to 15 gr., or **30 to 120 gr.** in ague.

Preparations.

1. Extractum Cinchonæ Liquidum.—Red cinchona bark powdered, 20 oz.; hydrochloric acid, 5 fl. dr.; glycerin, 2½ fl. oz.; alcohol (90 per cent.), q. s.; distilled water, q.s. *Standardized to contain 5 per cent. of total alkaloids, or 5 gr. in* 110 ♏.

Dose, 5 to 15 m.

2. Infusum Cinchonæ Acidum.—Red cinchona bark, 1; aromatic sulphuric acid, ¼; boiling water, 20. This is a solution of the sulphates of the alkaloids.

Dose, ½ to 1 fl. oz.

3. Tinctura Cinchonæ.—Red cinchona bark, 1;

alcohol (70 per cent.), 5. Percolate. *Standardized to contain 1 per cent. of total alkaloids, or 1 gr. in 110 ♏.*

Dose, ½ to 1 fl. dr.

4. Tinctura Cinchonæ Composita.—Tincture of cinchona, 10 fl. oz.; dried bitter orange peel, 1 oz.; serpentary, ½ oz.; saffron, 55 gr.; cochineal, 28 gr.; alcohol (70 per cent.), 10 fl. oz. Mix. *Standardized to contain 0·5 per cent. of total alkaloids, or ½ gr. in* 110 ♏.

Dose, ½ to 1 fl. dr.

It will be noticed that all preparations of cinchona bark are directed by the Pharmacopœia to be made from red cinchona bark, but quinine salts may be made from various kinds.

Quininæ Sulphas.—Quinine Sulphate. $([C_{20}H_{24}N_2O_2]_2H_2SO_4)_2,15H_2O$.

Source.—An alkaloid prepared from the powder of the various species of cinchona and remijia bark.

Characters.—Filiform, silky, very light, snow-white crystals, with an intensely bitter taste. *Solubility.*—1 in 800 of water, and giving it a fluorescent, bluish tinge; easily in slightly acidulated water (1 ♏ of a mineral acid in 2 fl. oz. of water will dissolve 1 gr. of sulphate of quinine), but reprecipitated by ammonia; the precipitate is soluble in excess of ammonia and in ether.

Impurities.—It should not contain more than 3 per cent. of cinchonidine, and no cinchonine, quinidine, or cupreine. Lime, chalk, magnesia, starch, and other white powders. Salicin, detected by its giving a blood-red colour with H_2SO_4.

Incompatibles.—Alkalies and their carbonates, astringent infusions.

Dose, 1 to 5 gr. (bitter), or **5 to 20 gr.** (antipyretic and anti-periodic).

Preparations.

1. Ferri et Quininæ Citras, *see* Iron, p. 175.

Dose, 5 to 10 gr.

2. Pilula Quininæ Sulphatis.—Quinine sulphate, 30; glycerin, 4; tartaric acid, 1; tragacanth, 1.

Dose, 2 to 8 gr.

3. Syrupus Ferri Phosphatis cum Quinina et Strychnina.—Each fl. dr. represents $\frac{4}{5}$ gr. of quinine sulphate (*see* p. 173).

Dose, ½ to 1 fl. dr.

4. Tinctura Quininæ Ammoniata.—Quinine Sulphate, 175 gr.; solution of ammonia, 2 fl. oz.; alcohol (60 per cent.), 18 fl. oz. Mix.

Dose, ½ to 1 fl. dr.

Quininæ Hydrochloridum.—Quinine Hydrochloride. $C_{20}H_{24}N_2O_2HCl,2H_2O$. Called Hydrochlorate of Quinine, B.P. 1885.

SOURCE.—An alkaloid obtained from the same source as sulphate of quinine.

CHARACTERS.—Crystals resembling those of the sulphate, but larger. *Solubility.*—1 in 35 of cold water, 1 in 3 of alcohol (90 per cent.). Very soluble in boiling water or boiling alcohol. Its solution gives a green colour with chlorine water and ammonia.

Dose, 1 to 10 gr.

Preparations.

1. Tinctura Quininæ.—Quinine hydrochloride, 175 grs.; tincture of orange, 1 pint. Dissolve.

Dose ½ to 1 fl. dr.

2. Vinum Quininæ.—Quinine hydrochloride, 20 gr.; orange wine, 1 pint.

Dose, ½ to 1 fl. oz.

Quininæ Hydrochloridum Acidum. — Acid Quinine Hydrochloride. $C_{20}H_{24}N_2O_2,2HCl,3H_2O$.

CHARACTERS.—The acid hydrochloride is a white crystalline powder, soluble in less than its own weight of water and yielding an acid liquid.

Dose, 1 to 10 gr.

ACTIONS OF CINCHONA BARK AND ITS ALKALOIDS.

The action of cinchona bark is due almost entirely to the **quinine** in it; the other alkaloids act in much the same way as this alkaloid, the sulphate and hydrochloride of which produce the same effect as quinine itself. The following description will be that of the action of quinine sulphate, which is often called quinine. Any differences between it and the bark or the other alkaloids will be mentioned in the course of this description.

External.—Quinine is a very powerful **antiseptic.** A solution of 1 in 500 destroys many forms of micro-organisms, and a solution of 1 in 250 prevents fermentation and putrefaction. Quinine is very fatal to all low forms of animal and vegetable life. A solution of 1 in 1000 kills many infusoria. No effect is produced upon the sound skin by quinine, but it is irritant to a raw surface.

Internal.—*Alimentary canal.*—Quinine acts like any other bitter, such as calumba. The bitter taste is very marked; in the mouth the gustatory nerves, and in the stomach the gastric nerves are stimulated. This leads reflexly to an increase of the salivary and gastric secretions, and to greater vascularity and peristalsis of the stomach, the appetite is sharpened, and digestion is aided. Quinine is, therefore, a **stomachic**. These effects, of course, bring about a better absorption of food; and hence, if digestion was previously feeble, the patient feels stronger after a course of quinine. In the stomach any salt of quinine is converted into a chloride, some of which is probably absorbed here; for in the intestines it would be precipitated by the alkaline secretions. It is often excreted unchanged in the fæces.

Blood.—Quinine, as the chloride, is readily absorbed into the blood; and although this is alkaline, it is not precipitated, being probably held in solution by the gases of the blood. It is not known that it undergoes any alteration there, but it produces some remarkable changes.

(*a*) *White corpuscles.*—If the movements of the white corpuscles are being watched in a drop of blood on the warm stage of the microscope, and some quinine is added, they at once cease. Again, if the mesentery of a living frog be put under the microscope, and slightly irritated so as to set up inflammation, emigration of the white corpuscles through the capillary walls, or diapedesis, as it is called, will be observed; if now some quinine be injected into the circulation this ceases, but those white corpuscles that have already passed out wander further from their capillary. If the quinine be applied locally to the mesentery, directly the white corpuscles have passed through their capillary their movement is stopped, and the motionless corpuscles collect in large numbers around the capillaries. It is clear, therefore, that quinine has the power of **arresting the movements of white blood-corpuscles.** In sufficient quantity it appears actually to destroy them, for in a cat killed by quinine they are much fewer in number than in a healthy cat.

(*b*) *Red corpuscles.*—Quinine is said to cause a diminution in the size of these, but this is most likely not strictly correct. In fever, if the temperature is high, the red corpuscles are probably a little larger than natural. If the temperature be reduced by any means the corpuscles regain their normal size. Quinine will reduce the temperature, but it probably has no special action on the corpuscles.

(*c*) *Acidity of the blood.*—Blood outside the body gradually becomes acid. Quinine prevents this.

(*d*) *Ozonizing power.*—If ozonized oil of turpentine be mixed with tincture of guaiacum, nothing occurs; but if a drop of blood be added, that transfers the ozone to the guaiacum, oxidizes it, and turns it blue. This **ozonizing power** of blood is **prevented** by the addition of quinine.

(*e*) *The stability of oxyhæmoglobin* is **strengthened** by quinine, so that the blood does not yield up its oxygen as easily as normally, consequently it cannot absorb oxygen readily. This inability of hæmoglobin to take up oxygen in the presence of quinine is parallel with its action on other varieties of protoplasm. For example, fungi absorb oxygen slowly if quinine be present, and thus fermentation may be prevented. Phosphorescent infusoria (the phosphorescence is due to rapid oxidization) lose this property in the presence of quinine. The ozonizing power of fresh vegetable juices is retarded by it.

Quinine is, therefore, very constant and very powerful in interfering with oxidation.

Circulation.—Small doses of quinine probably increase the activity of the heart reflexly because they stimulate the stomach; but large doses (larger than are given to man medicinally), either applied to the excised heart or circulating through it, directly paralyse the organ; the pulse becomes slower and more feeble, and the heart is finally arrested in diastole. Whether it acts on the muscle or the ganglia is not known. Large doses lower the blood-pressure considerably; this is owing partly to the effect on the heart, but it is probable that this fall of arterial pressure is due in part also to the action of quinine on the blood-vessels. If the spleen is enlarged as a result of malarial fever, the administration of quinine, curing the fever, leads to a decrease in the size of the spleen, but it has no direct effect on this organ, as is often asserted.

Respiration.—Although, as we have seen, quinine must, because of its retardation of oxidation, have a powerful influence on internal respiration, diminishing the activity of metabolism, it has but a moderate effect on the respiratory movements. Small doses slightly increase, large doses depress them.

Temperature.—Quinine has very little power over the healthy temperature, but that of fever is markedly reduced; it is, therefore, an energetic **antipyretic.** Considering its direct capability of diminishing metabolism in the tissues, it seems fair to assume that the drug **diminishes heat production**, and that it does so by acting directly on the thermogenetic tissues; but, whether it decreases heat production by also influencing the cerebral thermogenetic centres is not known.

Cerebrum.—Small doses are believed to stimulate cerebral activity. The results of experiments upon the action of quinine on the brain are so discordant as to be at present valueless. The effects of a large dose in man will be described under Cinchonism.

Spinal cord and nerves.—In frogs quinine causes a lessening of reflex excitability, which is removed by section below the medulla; but in large doses it produces a permanent diminution of reflex excitability. In these animals quinine also first excites and then paralyses the sensory nerves or their peripheral endings. The muscles are uninfluenced. These effects are not seen in man.

Uterus.—It has often been stated that quinine will lead to abortion, that it will when labour has commenced aid the expulsion of the fœtus, and that it will increase the menstrual flow if that is scanty. It appears that the first statement is certainly incorrect, and that the second and third are only correct for some women.

Kidneys.—After a full dose of quinine it is found in the urine in half an hour, and is slowly excreted for several days, but by far the greater part is eliminated within the first forty-eight hours. The excretion of uric acid is greatly diminished, that of urea and the other nitrogenous bodies in the urine is also considerably lessened. This confirms the statement already made that quinine retards considerably the metabolism of the body, but it should be stated that very little alteration is observed in the excretion of carbonic acid gas by the lungs. It is said that minute quantities of quinine are got rid of by all the secretions, as it may be detected in milk, saliva, bile, tears, &c., and it may be found in dropsical fluids if the patient has been taking it.

Cinchonism.—In many persons a dose of ten grains or more of quinine produces a train of physiological symptoms, chiefly from its influence on the nervous system. The patient soon complains of ringing in the ears, fulness in the head, and slight deafness. With larger doses these symptoms increase, disturbances of vision and giddiness are added, he may stagger when he walks, and the headache may be very intense.

Quinine is hardly ever given as a poison, but if it should be, all these symptoms of cinchonism will be very severe; the patient may be delirious and comatose, quite deaf and blind, and if he die it will be from collapse due to cardiac and respiratory failure. Great congestion of the middle ear and labyrinth is found in animals poisoned by quinine. The mild degrees of cinchonism pass off directly the drug is discontinued. Rarely quinine causes an erythêmatous rash, and it has been known to give rise to epistaxis. Those who work among cinchona barks may have a rash on their skin from the mechanical irritation of the powder.

Relative Action of the Alkaloids.—The other alkaloids are quite similar in their action to quinine, but they are not so powerful. Their relative antipyretic effect is quinine 100, quinidine 90, cinchonidine 70, cinchonine 40.

THERAPEUTICS.

External.—Quinine is too expensive for use as an antiseptic.

Internal.—*Gastro-intestinal tract.*—It is very largely used on account of its stomachic properties, chiefly for that variety of indigestion which is the outcome of general ill-health, want of fresh air, anæmia, &c., and not often when the stomach is the organ primarily at fault. The preparations of cinchona bark are very useful for this variety of dyspepsia; they contain quite enough of the alkaloids. The compound tincture has the advantage of containing other stomachics. Iron is very commonly given at the same time to correct the general condition. Quinine is frequently prescribed with the tincture of perchloride of iron, there is always enough free acid in this to dissolve any preparation of quinine. The dose of the sulphate or hydrochloride of quinine as a stomachic bitter is ½ to 2 gr. The acid hydrochloride is often preferable, as it is more soluble.

Antipyretic effect.—Quinine was commonly used as an antipyretic, but for the rare occasions on which antipyretic drugs are required, it has now been replaced by those which are more certain, as phenacetin, acetanilide, and phenazone. It is, however, a very fairly certain antipyretic. It is best given for this purpose in a single dose of 20 to 40 grains for an adult. Such large doses may be prescribed either as a solution of the hydrochloride, or as the sulphate suspended in milk. About one or two hours elapse before the temperature begins to fall. Quinine is more efficacious in reducing a temperature just beginning to fall than a rising one. Hence if possible it should be administered an hour or two before the time at which previous experience of the particular case shows the temperature will probably attain its maximum; then the fall will be more marked and last longer than if the drug had not been given.

Specific action.—Quinine, and to a less extent the other cinchona alkaloids, have the remarkable property of arresting the paroxysms of malarial fever. If 15 to 30 grains be taken about one or two hours before the attack is due, it will not take place, or it will be very mild. The same effect will be produced if smaller doses, about 5 grains, have been taken four or five times a day during the period between the attacks. Not only is it thus prophylactic, but the continued use of it is curative. It is also preventive, even if the persons to whom it has been given have never had ague. For this purpose it is administered to soldiers and sailors who have to enter malarious regions, and it is then found that few of them get ague. If the disease is very severe it is best to give single large doses.

If a person has once had ague, illnesses that he subsequently suffers from are liable to assume a malarial type. This is especially the case with neuralgia, which is then peculiarly paroxysmal. It is often on the forehead, when it is called brow ague. In such illnesses the effect of quinine is frequently very well marked, and a cure speedily takes place. Sometimes neuralgia which is not malarial is temporarily benefited. Quinine cures ague by acting, while circulating in the blood, as a direct poison to the hæmatozoa (protozoa), which infest the blood and are the cause of ague. It has been given for a host of diseases, especially septicæmia, but there is not any evidence that it does good to any, except those mentioned.

The preparations of the bark contain so little quinine that they cannot be used as antipyretics or antiperiodics.

Quinine should if possible be avoided in (1) persons suffering from acute or subacute disease of the middle ear; (2) those suffering from gastro-intestinal irritation, which it may increase; (3) those people, occasionally met with, in whom quite small doses produce very severe symptoms of cinchonism.

Both hydrobromic acid and ergotin are said to diminish the liability to cinchonism.

If it is wished to give quinine hypodermically the best salts are the official acid hydrochloride or the acid hydrobromide, 3 to 12 ♏ of a solution of 1 gr. in 6 ♏ of water may be used.

Warburg's tincture is a medicine which has a very high reputation in India for malaria. It has been called Tinctura Antiperiodica. The published formula states that it is a tincture made with alcohol (57 per cent.), and containing quinine sulphate, 1 in 50; Socotrine aloes, 1 in 40; opium, 1 in 4000; rhubarb, 1 in 125; camphor, 1 in 500; with angelica seed, elecampane, saffron, fennel, gentian, zedoary, cubebs, myrrh, and white agaric as aromatics. Dose, 1 to 4 fl. dr. It is often prescribed to be made without the aloes.

SALICIN.

Salicinum.—$C_6H_{11}O_5 \cdot OC_6H_4 \cdot CH_2OH$. A crystalline glucoside obtained from the bark of various species of *Salix* and of *Populus* (Nat. Ord. *Salicineæ*).

CHARACTERS.—Colourless, shining, trimetric, tabular crystals of a bitter taste. Coloured red with sulphuric acid. *Solubility.*—1 in 28 of cold water, 1 in 1 of boiling water, 1 in 60 of alcohol (90 per cent.). Not in ether.

Dose, 5 to 20 gr.

Acidum Salicylicum.—Salicylic Acid. $C_6H_4OH \cdot COOH$.

SOURCE.—Made by the interaction of sodium carbolate and carbonic acid gas. Thus dry carbonic anhydride is passed through sodium carbolate heated to 400° F. $C_6H_5ONa + CO_2 = NaC_7H_5O_3$ (sodium salicylate). This is treated with hydrochloric acid. $NaC_7H_5O_3 + HCl = NaCl + HC_7H_5O_3$ (salicylic acid).

Or salicylic acid may be obtained from natural salicylates, such as the oil of winter-green (*Gaultheria procumbens*, Nat. Ord. *Ericaceæ*), which contains methylsalicylate, or the oil of sweet birch, *Betula lenta* (Nat. Ord. *Betulaceæ*).

CHARACTERS.—Distinct, prismatic, colourless crystals. Inodorous. Taste first sweetish, then acid. Light, easily diffused, irritating to the nostrils. Melt at 313° F. *Resembling salicylic acid.*—Strychnine, but the crystals of strychnine are larger, non-irritating, less soluble, solution very bitter. *Solubility.*—1 in 500 of water. Readily in alcohol, ether, hot water, solutions of ammonium citrate, ammonium acetate, sodium phosphate, or borax. The natural acid is not quite so soluble as the artificial. Aqueous solutions give a reddish violet colour with perchloride of iron.

INCOMPATIBLE.—Spirit of nitrous ether.

IMPURITIES.—Orthocresotic and paracresotic acids. These exist only in artificial salicylic acid.

Dose, 5 to 20 gr.

Preparation.

Unguentum Acidi Salicylici.—Salicylic acid, 1 gr.; white paraffin ointment, 49 gr.

Salicylic acid is contained in Injectio Cocainæ Hypodermica.

Sodii Salicylas.—Sodium Salicylate. $(C_6H_4 \cdot OH \cdot COONa)_2, H_2O$.

Source.—Obtained by acting on sodium carbonate or caustic soda with salicylic acid.

Characters.—Small colourless scales or pearly tabular crystals. Odour none. Taste sweetish saline. *Solubility.*—1 in 1 of water, 1 in 6 of alcohol (90 per cent.).

Incompatible.—Hydrobromic acid for sodium bromide is formed and salicylic acid is precipitated.

Impurities.—Orthocresotic and paracresotic acids.

Dose, 10 to 30 gr.

For Bismuthi Salicylas *see* p. 168, and for Salol *see* p. 426.

ACTION OF SALICIN, SALICYLIC ACID, AND SODIUM SALICYLATE.

External.—Salicin and salicylic acid are **antiseptics** rather more powerful than carbolic acid. They are stimulant and mildly irritant to the skin. Locally applied they **check sweating**. The **salts of salicylic acid** are **not antiseptic**.

Internal.—*Alimentary tract.*—When inhaled or applied to the throat, salicylic acid is irritating, causing sneezing and cough. In the stomach also it is irritant, giving rise to pain, nausea, and vomiting unless well diluted, and should therefore never be given as pill or powder. The sodium salt and salicin are much less irritating. The glucoside salicin is in the bowel converted into glucose and saligenin, $C_7H_8O_2$, and this is further decomposed into salicylic acid, salicyluric acid, $HC_9H_8NO_4$, and salicylous acid, $HC_7H_5O_2$. The bile is rendered much less viscid.

Blood.—Salicylic acid, whether taken directly or formed in the bowel from the decomposition of salicin, is rapidly absorbed in spite of its insolubility, and therefore it is probably taken up as sodium salicylate; anyhow, this is the form in which it circulates in the blood, and consequently the following description will apply whether salicin, salicylic acid, or sodium salicylate has been taken. It has been thought also to exist in the blood as an albuminate, but of this there is no evidence, nor for the theory that when the sodium salicylate meets with carbonic acid salicylic acid is set free. Some of the salicylic acid of the sodium salt unites with glycocoll, forming salicyluric acid, which appears in the urine. Thus: $HC_7H_5O_3 + C_2H_5NO_2$ (glycocoll) $= HC_9H_8NO_4$ (salicyluric acid) $+ H_2O$. It will be noticed that this change is precisely analogous to the conversion of benzoic into hippuric acid by its union with glycocoll. Binz has suggested that the specific beneficial effect of salicylates in acute rheumatism is due to setting free of salicylic acid in the inflamed part by the carbonic acid in it. The beneficial effect of this acid is also seen in a disease of bees known as foul brood, and due to certain schizophytes, for feeding the creatures on syrup containing salicylic acid cures them.

Heart.—Salicin and salicylic acid are often stated to depress the force of the heart and cause a fall of blood-pressure. Careful comparison shows that salicin is not nearly so depressant as the acid—in fact, it is probable it has not this action at all unless given in toxic doses. Further, natural salicylic acid is not so depressant as the artificial variety. For example, Charteris found that 30 grains of salicin, or 10 grains of natural salicylic acid, or 32 grains of natural sodium salicylate had no injurious effect on a rabbit, but that much smaller doses than these of the artificial acid or its salt killed the animal. The artificial variety was found to contain orthocresotic and paracresotic acids, and these are powerful **cardiac depressants.** Thus it seems probable that the depressing effects commonly ascribed to salicylic acid are really due to the impurities of the artificial form.

Respiration.—Moderate doses have very little effect on respiration. Toxic doses strongly depress it.

Temperature.—In medicinal doses salicin and salicylic acid have no influence on the temperature of man, in toxic doses they slightly lower it; but they readily depress a febrile temperature, and are therefore called **antipyretics.** They cause a slight increase of perspiration, but this is not sufficient to explain the fall.

Salicylic acid and salicin are **antiperiodic.**

Nervous system.—We know little of the effect of salicylic acid on the individual parts of the nervous system. The clinical symptoms known as salicylism will be described presently.

Kidney.—Salicylic acid escapes chiefly through the kidneys. It to a much less extent also leaves the body by the sweat, the saliva, the bronchial secretions, and the fæces. It appears in the urine very soon after its ingestion (in from 10 to 30 minutes), but the elimination goes on slowly. It is excreted as salicyluric acid and sodium salicylate, which is split up by the phosphoric acid in the urine, yielding salicylic acid. The dark greenish colour of the urine sometimes seen is due to small quantities of either indican or pyrocatechin. Occasionally salicylic acid causes hæmaturia, due to congestion of the kidneys. Large doses increase the nitrogenous elimination, the uric acid being especially increased. The sulphur also is increased. It renders the urine antiseptic, and the salicyluric acid in that fluid will reduce Fehling's solution. The urine of patients taking it gives a **purple colour** with **perchloride of iron.**

Uterus.—It may cause abortion.

Salicylism.—In a large number of the persons to whom salicylic acid or its salt is given a train of symptoms is produced to which the above name has been applied. They are very like those produced by quinine. The cause of at least some of them is the impurities existing in artificial salicylic acid, but it is stated that the natural acid may give rise to them.

The commonest is deafness, which is often accompanied by ringing in the ears. Headache is also very frequent. The administration of the drug is usually stopped when these symptoms show themselves, but if it is continued the patient becomes violently delirious, there is nausea and vomiting, the face is flushed, and the other symptoms increase in severity. The pulse falls in both frequency and force, it becomes irregular, epistaxis is common, and hæmorrhages from other parts of the body have been recorded, such as hæmaturia and retinal hæmorrhage. Albuminuria without hæmaturia has been observed. One of the rarest symptoms is erythema or urticaria. Very large doses may cause the breathing to become weaker, and death may take place either from cessation of the heart or of the respiratory movements.

THERAPEUTICS.

External.—The ointment may be used when an antiseptic stimulating ointment is required. A collodion composed of salicylic acid, a drachm ; collodium flexile, an ounce ; a glycerin containing 10 per cent. of salicylic acid ; and a plaster, also 10 per cent., are good preparations. Strong applications of salicylic acid are very useful for removing excess of epidermis, warts, or corns. Salicylic acid 11 parts, Extract of Cannabis Indica 2 parts ; Collodion flexile 87 parts, form an excellent remedy (commonly known as green solution) for soft corns. Powdered salicylic acid mixed with starch or chalk may be employed to check profuse perspiration of the feet and axillæ. The German Pharmacopœia has for this purpose a Pulvis Salicylicus cum Talco (salicylic acid, 3 ; wheaten starch, 10 ; talc, in powder, 87). The sweats of phthisis may be treated in the same way. A little salicylic acid is often added to Thompson's fluid (p. 247).

Internal.—Salicylic acid is a specific for rheumatic fever; it lowers the temperature, lessens the swelling, leads to a rapid cessation of pain, and diminishes the liability to pericarditis and other complications. It must be given well diluted to prevent dyspepsia. The sodium salt is often preferred as being the most soluble, but in order to diminish the risk of salicylism it should be prepared either from pure artificial or from natural salicylic acid. If the attack is severe, 20 grains every two or three hours should be given for the first twelve or twenty-four hours; then, if the patient is doing well, the frequency of the dose may be gradually diminished, but it should be continued thrice daily for ten days after the temperature is normal and the pain has ceased. Salicin is not so powerful as sodium salicylate, but it is said to be less depressant than the synthetic acid.

These preparations are of no use for gout or severe osteo-arthritis, but occasionally the pains of chronic rheumatism are somewhat relieved.

Salicylic acid or salicin may produce a fall of temperature in any fever, but, as we have more certain antipyretics, they are not used except for rheumatic fever.

Some writers say they have found salicylic acid useful in migraine, sciatica, diabetes, and diphtheria, but it is probably of little value for these disorders.

It has been given to render the urine acid in cases of alkaline urine and cystitis, but there are better remedies for this purpose.

It has also been given in cases of gall stone with the object of rendering the bile less viscid.

SALOL.

Salol.—Phenyl salicylate. $C_6H_4{\cdot}OH{\cdot}COO{\cdot}C_6H_5$.

Source.—Prepared by the interaction of salicylic acid and phenol, or of their sodium salts with phosphoryl chloride or carbonyl chloride.

Characters and Tests.—Small colourless crystals of a faint aromatic odour and almost tasteless. *Solubility.*—Not in water; 1 in 10 in alcohol (90 per cent.), 3 in 1 in ether or chloroform. Contains 60 parts of salicylic and 40 of carbolic acids.

Dose, 5 to 15 gr. in cachets or suspended in milk. The large quantity of carbolic acid in salol renders caution necessary when large doses are given.

ACTION AND THERAPEUTICS.

External.—It is an antiseptic, and when mixed with talc (1 in 5) may be used as a dusting powder.

Internal.—In the intestine salol splits up into carbolic and salicylic acids, and the former may render the urine dark.

In rheumatic fever it is efficacious on account of the salicylic acid it contains, but it has no advantage over salicin or salicylic acid, and the carboluria may be troublesome. It is used as an intestinal disinfectant. These have been discussed when describing naphthol (p. 300) and on p. 88. It disinfects the urinary tract.

HYDRASTIS.

Hydrastis Rhizoma.—Hydrastis Rhizome. The dried rhizome and rootlets of *Hydrastis canadensis*, the golden seal, yellow-root, or yellow puccoon (Nat. Ord. *Ranunculaceæ*). Grows in the Alleghanies.

CHARACTERS.—Rhizome is $\frac{1}{2}$ to $1\frac{1}{2}$ in. long, $\frac{1}{8}$—$\frac{1}{2}$ in. thick; irregular twisted appearance, with thin rootlets 3 to 5 in. long. Scars of decayed stems on the upper surface. Yellowish brown with short fracture. Interior yellow. Taste very bitter.

COMPOSITION.—It contains—(1) Beberine, an alkaloid. (2) Hydrastinine, an alkaloid $C_{11}H_{11}NO_2$. (3) Xantho-puccine.

Preparations.

1. **Extractum Hydrastis Liquidum.**—Powdered hydrastis rhizome, 20 oz.; alcohol (45 per cent.), 20 fl. oz.

Dose, 5 to 15 m.

2. **Tinctura Hydrastis.**—Powdered hydrastis rhizome, 1; alcohol (60 per cent.), 10. Percolate.

Dose, 30 to 60 m.

ACTION.

Hydrastis in moderate doses acts as a gastric bitter, promoting the appetite, stimulating the gastric secretions, and peristalsis. It increases the flow of bile and urine. It will contract the unstriped muscle of all arteries and, to a slight extent, that of the uterus, and it is therefore hæmostatic in uterine hæmorrhage. It is mildly antiperiodic. In poisonous doses it stops the heart, causing a great fall of blood-pressure.

THERAPEUTICS.

External.—Hydrastis is employed empirically as a local stimulating application in chronic inflammations, such as unhealthy ulcers. It is used also as a lotion in hyperidrosis, acne, and seborrhœa. Either of the preparations may be employed, if diluted with water.

Internal.—The chief use of hydrastis is that it is empirically administered for chronic inflammations of mucous membranes. It is said to be especially valuable for uterine affections, in the chronic gastritis of drunkards, and to a rather less degree in other forms of chronic gastro-intestinal catarrh. As an injection or lotion it is employed (either preparation diluted with an equal part of water) for chronic nasal catarrh, otorrhœa, leucorrhœa, gonorrhœa, and as a mouth wash in aphthous stomatitis, chronic pharyngitis, &c. It is given to stop uterine hæmorrhage and to arrest the growth of uterine tumours. As an antiperiodic it is far inferior to quinine.

GROUP V.

Vegetable Purgatives.

CLASS I.—Laxatives.

Prune, Fig, Tamarind, Cassia, Castor Oil (small doses).

CLASS II.—Simple purgatives.

Castor Oil, Rhubarb, Senna, Cascara Sagrada, Aloes.

CLASS III.—Drastic purgatives.

Scammony, Jalap, Croton Oil, Colocynth, Elaterium, Gamboge.

CLASS IV.—Cholagogues.

Podophyllum, Euonymin, Iridin.

CLASS I.—**Laxatives.**

PRUNES.

Prunum.—The dried ripe fruits of *Prunus domestica*, the plum (Nat. Ord. *Rosaceæ*). South of France.

CHARACTERS.—Ovoid-oblong, $1\frac{1}{4}$ in. long, black, shrivelled; brownish pulp; sweet mucilaginous taste.

COMPOSITION.—The chief constituents are—(1) Sugar, (2) malic acid, and (3) a purgative principle.

Prunes are contained in Confectio Sennæ, 6 in 75.

ACTION AND THERAPEUTICS.

Prunes are demulcent and slightly laxative. They may be eaten as articles of diet in cases of slight constipation.

FIGS.

Ficus.—The dried fleshy receptacles of *Ficus carica* (Nat. Ord. *Urticaceæ*). Smyrna.

CHARACTERS.—Well known.

COMPOSITION.—The chief constituents are—(1) Sugar, 62 per cent. (2) Gum.

Figs are contained in Confectio Sennæ, 12 in 75.

ACTION AND THERAPEUTICS.

Figs are a pleasant food and mildly purgative, forming a convenient remedy for slight constipation.

TAMARINDS.

Tamarindus.—The fruit of *Tamarindus indica* freed from the brittle outer part of the pericarp and preserved with sugar (Nat. Ord. *Leguminosæ*). West Indies.

Characters.—A reddish-brown, moist, sugary mass, enclosing strong-branched fibres, and brown, shining seeds, each enclosed in a tough membranous coat. Taste agreeable, refreshing, subacid.

Impurity.—Copper.

Composition.—The chief constituents are—(1) Tartaric acid and potassium tartrate. (2) Citric, acetic, and other acids. (3) Sugar.

Tamarind is contained in Confectio Sennæ, 9 in 75.

Action and Therapeutics.

Tamarind is pleasant and acid to the taste, and a mild laxative. It may be made into tamarind whey (1 part of tamarinds to 30 of milk) and given as an acid, cooling, slightly purgative drink in fevers. It is a good purgative for children, and may be spread on bread and butter.

CASSIA PULP.

Cassiæ Pulpa.—The pulp obtained from the pods recently imported of *Cassia fistula*, the purging cassia (Nat. Ord. *Leguminosæ*). East or West Indies.

Characters.—The pods are 1½ to 2 feet long, 1 in. in diameter. Shortly stalked, pointed, blackish brown, very hard, indehiscent; divided internally by their transverse partitions into numerous cells, each containing a solitary smooth, flat, oval, reddish-brown seed, surrounded by pulp. The pulp, which alone is official, is viscid, blackish brown, sweet in taste, sickly in odour.

Composition.—The chief constituents are—(1) A purgative principle closely allied to cathartic acid. (*See* Senna, p. 435.) (2) Sugar 60 per cent.

Cassia pulp is contained in Confectio Sennæ, about 9 in 75.

Action and Therapeutics.

It is a laxative, only given in confection of senna.

Class II.—Simple Purgatives.

CASTOR OIL.

Oleum Ricini.—The fixed oil expressed from the seeds of *Ricinus communis* (Nat. Ord. *Euphorbiaceæ*). India.

CHARACTERS.—Viscid, colourless or pale yellow. Odour faint, characteristic. Taste acrid, unpleasant. *Solubility.*—1 in 1 of absolute alcohol, 1 in 5 of alcohol (90 per cent.).

COMPOSITION.—The chief constituents are—(1) *Ricinoleate of glyceryl*, $C_3H_5(C_{18}H_{33}O_3)_3$. This constitutes the chief bulk. (2) Other fixed oils, as palmitin, stearin, &c. (3) Possibly an alkaloid, ricinine, not purgative. (4) According to some authorities an active principle which has not yet been isolated.

Dose, 1 to 8 fl. dr.

Preparation.

Mistura Olei Ricini.—Castor oil, 3 fl. oz. orange-flower water of commerce, 1 fl. oz.; mucilage of gum acacia, 1½ fl. oz.; cinnamon water, 2½ fl. oz. (Contains 3 fl. dr. of castor oil in 1 fl. oz.)

Dose, 1 to 2 fl. oz.

Castor oil is contained in Collodium Flexile, Linimentum Sinapis, and Pilula Hydrargyri Subchloridi Composita. (Castor-oil seeds are not official, but it is important to recognise them. They are ⅔ in. long and ⅓ in. wide, ovoid, flattened. The seed is prolonged into a sharp beak. Epidermis shiny grey, marked by brownish bands and spots. Kernel white. They contain 50 per cent. of the oil, and an acrid substance which makes them poisonous. Three castor-oil seeds have been known to kill an adult man.)

ACTION.

External.—Castor oil is, like olive oil, protective and sedative, and may be used to drop into the eye when the conjunctiva is inflamed, and as a solvent for homatropine, but this solution is occasionally a little irritating.

Internal.—*Gastro-intestinal tract.*—The nastiness of castor oil is mostly due to the smell, and is not noticed much if the nose is held when the oil is drunk. Medicinal doses produce no effect on the stomach. Reaching the intestine the oil is an excellent **simple laxative** or mild purgative, acting in about five hours, and causing no griping nor subsequent constipation. The motion is soft but not liquid. Castor oil will purge even when rubbed into the skin.

How it acts is unknown. It has been thought that the ricinoleate of glyceryl in the oil is decomposed in the duodenum, and the ricinoleic acid purges, but this is probably incorrect. The most likely view is that the oil contains some purgative principle which has not yet been isolated. Probably the seeds contain much more of this than the oil, for they are ten times more purgative, a fact which it is impossible to explain if it is the ricinoleic acid which purges. Castor oil will purge when given *per rectum.*

Mammary glands.—Applied locally to the breasts it is said to be **galactogogue.**

THERAPEUTICS.

Castor oil is perhaps the best simple purgative we have, and is very useful in cases in which there is slight temporary constipation. Being mild in its action it is very suitable for getting rid of undigested food that is causing diarrhœa, and a dose of castor oil with a minute quantity of laudanum in it is a favourite remedy for certain forms of diarrhœa. It is also especially convenient in pregnancy, after delivery, and when in any abdominal disease, as typhoid fever, peritonitis, or when, after abdominal operations, the irritation caused by the fæces makes it absolutely necessary to get the bowels open. Also it is very useful for children, or for very old or infirm persons, or for those suffering from piles or fissures. It is a good purgative to give before and after the use of anthelmintics.

Its nastiness is the only objection to it. As already mentioned, this can largely be overcome by holding the nose, and there are many forms of castor oil in the market so prepared as to be almost colourless and odourless. It may be taken in capsules, but they are bulky. The pharmacopœial mixture is not to be recommended. Lemon juice or coffee conceals the taste to some extent, or the oil may be added to a teaspoonful of peppermint water, and then a little brandy added till the oil neither sinks nor swims. If the inside and rim of the glass are moistened with the vehicle, the oil, which should, if possible, be between two layers of the vehicle, is hardly tasted.

As an enema (castor oil 1 fl. oz., warm mucilage of starch 11 fl. oz., mix thoroughly) it is useful when a mild injection is required.

Breasts.—The leaves of the castor-oil plant applied to the breasts will sometimes induce the secretion of milk. A fluid extract of them may also be taken three or four times a day.

RHUBARB.

Rhei Radix.—Rhubarb Root. The erect rhizome or so-called root, partly deprived of its bark and dried, of *Rheum palmatum*, *Rheum officinale* (Nat. Ord. *Polygaleæ*), and probably other species. China and Thibet.

Characters.—Cylindrical, conical, plano-convex, or irregular pieces. Outer surface sometimes covered with a bright yellowish powder; rounded or angular, smooth or a little wrinkled, showing beneath the powder reddish-brown lines mixed with a yellowish-brown substance, and usually small star-shaped spots. The pieces are often bored with a hole, which may contain the remains of the cord used to suspend them to dry. Internally hard, compact, fracture uneven, and with a marbled appearance. Odour peculiar, aromatic. Taste feebly astringent, bitter; there is gritty feeling between the teeth when chewed.

Composition.—The chief constituents are—(1) *Chrysarobin* (*synonyms*, rhein, chrysophan, *see* Chrysarobinum). (2) *Chrysophanic acid.* It is not known whether, when alive, rhubarb contains any chrysophanic acid, for when kept the chrysarobin quickly oxidizes to chrysophanic acid. The purgative properties are due to the chrysarobin, which also gives the yellow colour. (3) *Rheotannic acid*, to which the astringency of rhubarb is due. (4) *Oxalate of lime*, 35 per cent., to which the grittiness is due. (5) Other bodies, about which little or nothing is known, viz. phæorrhetin, emodin, erythrorrhetin, resins, aporrhetin, and rheumic acid.

IMPURITIES.—English rhubarb; different taste, smell, and excess of starch. Turmeric which is turned brown by boric acid.

Dose, 3 to 10 gr. (repeated administration), **15 to 30 gr.** (single administration).

Preparations.

1. **Extractum Rhei.**—Alcoholic.
Dose, 2 to 8 gr.

2. **Infusum Rhei.**—1 in 20 of boiling water.
Dose, ½ to 1 fl. oz.

3. **Liquor Rhei Concentratus.**—Percolated in the usual way for concentrated liquors. *See* p. 18.
Dose, ½ to 1 fl. dr.

4. **Pilula Rhei Composita.**—Rhubarb, 6; Socotrine aloes, 4½; myrrh, 3; hard soap, 3; oil of peppermint, ⅓; syrup of glucose, 5½.
Dose, 4 to 8 gr.

5. **Pulvis Rhei Compositus.** *Synonym.*—Gregory's powder. Rhubarb, 2; heavy or light magnesia, 6; ginger, 1.
Dose, 20 to 60 gr.

6. **Syrupus Rhei.**—Rhubarb, 2; coriander, 2; sugar, 24; alcohol (90 per cent.), 8; water, 24.
Dose, ½ to 2 fl. dr.

7. **Tinctura Rhei Composita.**—Rhubarb, 2; cardamoms, ¼; coriander, ¼; glycerin, 2; alcohol (60 per cent.), 18. Percolate.
Dose, ½ to 1 fl. dr. (repeated administration), **2 to 4 fl. oz.** (single administration).

ACTION.

External.—Probably rhubarb would have, to a mild degree, the same action as Goa powder, but it is never applied externally.

Internal.—*Alimentary canal.*—In the mouth, rhubarb increases the flow of saliva; and in the stomach, in small doses, it, like any other bitter substance, stimulates the flow of gastric juice, and the vascularity and peristaltic movements of the stomach. It is, therefore, a **stomachic**, and will aid digestion. In large doses it causes **purgation**, producing in from four to eight hours a liquid motion, coloured yellow by the chrysophan. The resinous constituents of rhubarb are said to increase the flow of bile, but certainly its cholagogue action is not sufficiently powerful to explain completely its purgative properties. It is commonly stated to exaggerate very actively intestinal peristalsis, but there is no adequate proof of this. It is liable to gripe. The purgation is followed by constipation; this is ascribed to the rheo-tannic acid: if so, it is probably absorbed and subsequently re-excreted into the intestine, otherwise it would all be swept away in the purging.

Kidneys.—The colouring matter is excreted in the urine, and stains it yellow. The urinary flow is slightly increased.

THERAPEUTICS.

Rhubarb is commonly given to children as a stomachic purgative in indigestion, especially when caused by errors of diet, for it clears away any undigested food, and its stomachic and after-astringent effects are valuable. In the same way it is useful in diarrhœa due to irritation caused by undigested food; here the after-astringency is especially serviceable. A powder of powdered rhubarb and sodium bicarbonate (which hides the taste) equal parts, with some powdered gentian, or a similar fluid medicine, forms an excellent stomachic for young children. Rhubarb should never be given alone, because of the griping it causes.

SENNA.

Senna Alexandrina.—Alexandrian Senna. The dried leaflets of *Cassia acutifolia* (Nat. Ord. *Leguminosæ*). Alexandria.

CHARACTERS.—$\frac{3}{4}$ to $1\frac{1}{4}$ in. long, lanceolate or oval-lanceolate, acute, unequal at the base, entire, thin, brittle, pale greyish green. Finely pubescent. Veined on the lower surface.

Odour peculiar, faint, tea-like. Taste mucilaginous, sickly. *Resembling senna.*—Leaves of *Solenostemma Argel*, Uva Ursi, and Barosma, all equal at the base.

IMPURITIES.—Any of the above.

Senna Indica.—East Indian Senna. *Synonym.*—Tinnivelly senna. The dried leaflets of *Cassia angustifolia* (Nat. Ord. *Leguminosæ*). Southern India.

CHARACTERS.—1 to 2 in. long, lanceolate, acute, unequal at the base, thin, entire, yellowish green and smooth above, duller beneath; glabrous or slightly pubescent. Odour and taste like Alexandrian senna.

COMPOSITION OF BOTH KINDS.—The chief constituents are—(1) *Cathartic acid*, an amorphous sulphurated glucoside. $C_{180}H_{192}N_{82}SO_2$. It exists as salts of earthy bases, such as calcium and magnesium. These salts are soluble in water. Cathartic acid is capable of decomposition into glucose and cathartogenic acid. It is the chief purgative principle in senna and other purgatives. (2) Other glucosides, sennacrol and sennapicrin, which do not in most preparations contribute to their action, as they are insoluble in water. (3) Chrysophanic acid in small amounts as a colouring matter (*see* Rhubarb and Chrysarobinum). (4) A peculiar unfermentable sugar, catharto-mannite.

Preparations of either Kind.

1. **Confectio Sennæ.**—Senna, 7; coriander fruit, 3; figs, 12; tamarind, 9; cassia pulp, 9; prunes, 6; extract of liquorice, 1; sugar, 30; water, to make 75.

Dose, 60 to 120 gr.

2. **Infusum Sennæ.**—Senna, 1; ginger, $\frac{1}{16}$; boiling water, 10.

Dose, $\frac{1}{2}$ to 1 fl. oz., or as a single draught, **2 fl. oz.**

3. **Liquor Sennæ Concentratus.**—Percolate with water. *See* p. 18.

Dose, $\frac{1}{2}$ to 1 fl. dr.

4. **Mistura Sennæ Composita.** *Synonym.*—Black draught; magnesium sulphate, 5| oz.; liquid extract of liquorice, 1 fl. oz.; aromatic spirit of ammonia, 1 fl. oz.; compound tincture of cardamoms, 2 fl. oz.; infusion of senna, q.s. to make 20 fl. oz.

Dose, 1 to 2 fl. oz.

5. Pulvis Glycyrrhizæ Compositus.—Senna is the most important constituent, 2 in 12 (*see* p. 543).
Dose, 60 to 120 gr.

6. Syrupus Sennæ.—Senna, 40 oz.; oil of coriander, 10 ♏; sugar, 50 oz.; alcohol (90 per cent.), 40 ♏; alcohol (20 per cent.), 70 fl. oz.
Dose, ½ to 2 fl. dr.

7. Tinctura Sennæ Composita.—Senna, 4 oz.; raisins, 2 oz.; caraway, ½ oz.; coriander, ½ oz.; alcohol (45 per cent.), 1 pint. Macerate.
Dose, ½ to 1 fl. dr. for repeated administration; **2 to 4 fl. dr.** for single administration.

ACTION.

External.—None.

Internal.—Senna, because of the cathartic acid in it, stimulates the muscular coat of the intestine, especially the colon, and produces some hyperæmia. Consequently the fluid contents of the small intestine are hurried through the colon, and pale yellow watery stools, containing some undigested food, are the result. Senna acts very feebly or not at all on the biliary secretion. Large doses open the bowels several times and produce **griping**, but not much hyperæmia. Probably there are other substances in senna beside cathartic acid having a purgative property, but it is by far the most important. Purgation by senna does not cause subsequent constipation. Some constituents of it are absorbed, and may cause the urine to be red. It will purge if injected into the veins, and will impart its purgative properties to the milk of nursing women.

THERAPEUTICS.

Senna is a safe, useful purgative for cases of simple constipation. It is, because of its tendency to gripe and its nauseous taste, rarely given alone. The compound liquorice powder is to be preferred to the Mistura Sennæ ("black draught"), as this is a nasty mixture, Senna is largely used to complete the effect of duodenal purgatives, as we see in the old prescription of a blue pill at night and a black draught in the morning. Acting on the colon, it is valuable in slight cases of fæcal collection. Compound liquorice powder is much used in habitual constipation and the constipation of pregnancy. Confection of senna, coated with chocolate, forms the well-known purgative Tamar Indien, and in this form can be taken by children. It is said that the infusion contains more of the active principles than other preparations; it soon decomposes, but 1 gr. of nitre to the fl. oz. will prevent this.

CASCARA SAGRADA.

Cascara Sagrada. *Synonyms.*—Sacred Bark, Rhamni Purshiani Cortex. The dried bark of *Rhamnus purshianus*, California buckthorn (Nat. Ord. *Rhamneæ*). From the North Pacific coast.

CHARACTERS.—Quills or nearly flat pieces. About 4 in. long, $\frac{3}{4}$ in. wide, and $\frac{1}{16}$ in. thick. Smooth purplish-brown cork almost covered with lichens; inner surface brown, nearly smooth, and striated longitudinally. Fracture short externally, fibrous internally. Characteristic odour. Bitter taste.

COMPOSITION.—The chief constituents are Cascarin, several resins, a neutral substance, various acids, and a volatile oil.

Preparations.

1. Extractum Cascaræ Sagradæ.—Made by percolation with water.

Dose, 2 to 8 gr.

2. Extractum Cascaræ Sagradæ Liquidum.—Made with alcohol (90 per cent.) and water.

Dose, $\frac{1}{2}$ to 1 fl. dr.

3. Syrupus Cascaræ Aromaticus.—Liquid extract, 8; tincture of orange, 2; alcohol (90 per cent.), 1; cinnamon water, 3; syrup, 6.

Dose, $\frac{1}{2}$ to 2 fl. dr.

ACTION AND THERAPEUTICS.

Cascara sagrada is a **simple laxative** and aperient, not causing much griping, and resembling in its action frangula bark, which is no longer official and is now rarely used, but it is more certain and more active. The bitter principle gives it stomachic properties. It is very serviceable for constipation, especially if chronic. A single pharmacopœial dose may either be taken in the evening, or 10 to 15 ♏ of the liquid extract may be given three times a day before meals. One advantage of its use is that gradually increasing doses are not required. The liquid extract is very bitter; this taste may be concealed by aromatics, liquorice, or sal volatile, and it may be given in chloroform water. The aromatic syrup conceals the bitter taste very well.

ALOES.

Aloe Barbadensis.—Barbados Aloes. The juice that flows from the transversely cut leaves of *Aloe vera*, *Aloe chinensis*, and probably other species, evaporated to dryness (Nat. Ord. *Liliaceæ*). West Indies. The variety known as Curaçoa aloes, which is also official, is included under Barbados Aloes.

Characters.—Deep reddish-brown, chocolate-brown, dark brown, or almost black. Fracture usually dull and waxy with opaque splinters, sometimes smooth and glassy with transparent splinters. The opaque variety when moistened with alcohol (90 per cent.), and examined in a thin stratum under the microscope, shows numerous crystals. Powder dull olive-yellow. Odour strong, disagreeable. Taste bitter, nauseous. *Solubility.*—Almost entirely in alcohol (40 per cent.); 75 per cent. of Barbados aloes dissolves in water. *Resembling aloes.*—Resins of guaiacum and jalap, which are not bitter.

Composition.—The chief constituents are—(1) *Aloin. Synonym.*—Barbaloin, which is official (*see* p. 441). (2) A resin. (3) A trace of gallic acid. (4) A trace of a volatile oil giving the odour.

Dose, 2 to 5 gr.

Preparations.

1. **Extractum Aloes Barbadensis.**—Aqueous. **Dose, 1 to 4 gr.**

2. Decoctum Aloes Compositum.—Extract of Barbados aloes, 2; myrrh, 1; saffron, 1; potassium carbonate, 1; extract of liquorice, 8; compound tincture of cardamoms, 60; water, up to 200. Contains of the extract, 4½ gr. in 1 fl. oz.

Dose, ½ to 2 fl. oz.

3. Tinctura Aloes.—Extract of Barbados aloes, ½; liquid extract of liquorice, 3; alcohol (45 per cent.), 17. Macerate.

Dose, ½ to 1 fl. dr. for repeated, **1½ to 2** for single administration.

4. Pilula Aloes Barbadensis. — Barbados aloes, 2; hard soap, 1; oil of caraway ⅛; confection of roses, 1.

Dose, 4 to 8 gr.

5. Pilula Aloes et Ferri.—Barbados aloes, 2; exsiccated ferrous sulphate, 1; compound powder of cinnamon, 3; syrup of glucose, 3.

Dose, 4 to 8 gr.

Barbados aloes is contained in Pilula Cambogiæ Composita (1 in 6), Pilula Colocynthidis Composita (1 in 3), and Pilula Colocynthidis et Hyoscyami (1 in 4½).

Extract of Barbados aloes is contained in Extractum Colocynthidis Compositum (1 in 2¼).

Aloe Socotrina.—Socotrine Aloes. The juice that flows from the transversely cut bases of the leaves of *Aloe Perryi*, and probably other species evaporated to dryness (Nat. Ord. *Liliaceæ*). The variety known as Zanzibar aloes, which is also official, is included under Socotrine Aloes. Probably very little of the so-called Socotrine aloes comes from Socotra.

Characters. — The Socotrine variety is viscid and brownish-yellow, or when dry in hard, dark brown or nearly black masses with a dull waxy uneven fracture. Odour strong, taste bitter. The Zanzibar variety is in liver-brown masses with a dull, waxy, smooth and even fracture. Both varieties are opaque in even small splinters, and show under the microscope minute crystals imbedded in a transparent mass. *Solubility.*—Almost entirely in alcohol (40 per cent.); 50 per cent. of Socotrine aloes dissolves in water. *Resembling aloes.*—Resins of jalap and guaiacum, which are not bitter.

Composition.—The same as Barbados aloes. The *aloin* is a little different, and is called Socoaloin, but the physiological properties of the two aloins, which are isomeric, are the same.

Dose 2 to 5 gr.

Preparations.

1. **Pilula Aloes Socotrinæ.**—Socotrine aloes, 2; hard soap, 1; oil of nutmeg, $\frac{1}{8}$; confection of roses, 1.
   Dose, 4 to 8 gr.

2. **Pilula Aloes et Asafetidæ.**—Socotrine aloes, asafetida, hard soap, confection of roses, of each 1.
   Dose, 4 to 8 gr.

3. **Pilula Aloes et Myrrhæ.**—Socotrine aloes, 2; myrrh, 1; syrup of glucose, $1\frac{1}{2}$.
   Dose, 4 to 8 gr.

Socotrine aloes is contained in Pilula Rhei Composita (1 in 6), Tinctura Benzoini Composita (1 in 60).

Aloin.—$C_{16}H_{16}O_7,3H_2O$. A crystalline neutral principle extracted from aloes by solvents and recrystallization.

Characters.—Tufts of yellow acicular crystals, odourless but tasting of aloes. *Solubility.*—Freely in hot fluids, sparingly in cold water or cold alcohol, not at all in ether. Rapidly altered by alkalies. The specimens of aloin are named according to the variety of aloes from which they are derived; thus we have barbaloin, socoaloin, nataloin (Natal), and zanaloin (Zanzibar). They differ very slightly from each other; they are isomeric, and their action is the same. Barbaloin is generally preferred. Aloin is the active principle of aloes, but it does not gripe so much.

Dose, $\frac{1}{2}$ to 2 gr.

Action of Aloes.

External.—Aloes has no external action on the unbroken skin, but it can be absorbed from a raw surface, for aloes sprinkled on an ulcer, to which it is a slight stimulant, will lead to purging.

Internal.—*Gastro-intestinal tract.*—In the stomach the bitter principle of aloes causes it to act as a **stomachic**, like other bitters. In the intestine it **increases** the rate of the flow of **bile**, and probably the amount secreted. It produces little influence in the small intestine, but the muscular coat of the **colon** is powerfully **stimulated**, and the intestinal secretion from that part slightly accelerated. Aloes, therefore, purges, and naturally takes some time, usually fifteen to twenty hours, to act; the motion is well formed, not very soft, as there is so little increased secretion of fluid, and it is dark coloured from the bile in it. Sometimes the drug gripes somewhat, because the muscular contraction it produces is irregular. As it acts chiefly on the lower bowel the habitual use of it may lead to piles.

Female genital organs.—Aloes will increase the menstrual flow; it is therefore an **emmenagogue.** It is excreted by the milk, for aloes given to the mother may purge the child. It is stated also to be excreted in the urine.

Barbados aloes is slightly more purgative than Socotrine aloes, and contains a greater proportion of substances soluble in water.

As a rule aloin acts like aloes, but it does not gripe so much. Some specimens, however, have very little action. This may be owing to adulteration, or differences in the composition of different specimens.

THERAPEUTICS.

Aloes is an excellent purgative for cases of habitual constipation, many of which are due to an imperfect contraction of the muscular coat of the large intestine. It is very commonly given as a dinner pill (1 gr. of extract of aloes and $\frac{1}{4}$ gr. of extract of nux vomica) to sufferers from chronic constipation, and in these cases its bitter principles acting as stomachics aid digestion. To avoid griping it is well to combine a little extract of hyoscyamus or a little extract of belladonna with it. One great advantage of aloes is that the dose need not be gradually increased. It is also very commonly given as a pill with nux vomica and a grain or two of the dried sulphate of iron to persons suffering from chlorosis and other forms of anæmia. It overcomes the chronic constipation so common in these cases, and some regard this as very important for the cure of the disease. The amenorrhœa so frequently associated with chlorosis is often benefited by aloes, and amenorrhœa due to other causes may also be relieved. Aloes is of great service in many cases of chronic constipation of children. A warm aqueous solution of aloin purges when injected subcutaneously.

Aloes must not be given in pregnancy, hæmorrhoids, or menorrhagia. An enema of it is anthelmintic.

CLASS III.—**Drastic Purgatives.**

SCAMMONY.

Scammoniæ Radix.—Scammony Root. T dried root of *Convolvulus scammonia* (Nat. Ord. *Convolvulaceæ*). Syria and Asia Minor.

CHARACTERS.—Cylindrical, except at upper end, where it is enlarged, and has remains of aërial stems; shrivelled, contorted, longitudinally furrowed. Externally, greyish brown or yellow. Internally, pale grey or white. Fractured surface very coarsely fibrous. Odour and taste like jalap, faint. *Resembling scammony root.*—Belladonna, which is smaller.

Scammonium.—Scammony. A gum-resin obtained by incision into the living root of *Convolvulus scammonia.* Known in commerce as Virgin Scammony.

CHARACTERS.—Flat, irregular cakes, ash-grey or blackish brown externally, sprinkled with grey powder. Very brittle. Fracture resinous, shining, porous, dark brown. Easily reduced to an ash-grey powder, forming an emulsion with water. Odour peculiar, cheesy. When chewed gives a pricking sensation.

IMPURITIES.—Chalk and starch.

COMPOSITION.—The chief constituents are—(1) *The resin* (q. v.), 75 to 80 per cent. (2) Gum, 10 to 20 per cent. (3) Starch.

Dose, 5 to 10 gr.

Scammoniæ Resina.—Resin of Scammony.

SOURCE.—Digest and percolate scammony root with alcohol (90 per cent.), precipitate the resin with water, wash it several times, and dry it.

CHARACTERS.—Brownish, brittle, translucent pieces; fracture resinous. Odour fragrant. Soluble in ether. Tincture of it does not blue the fresh-cut surface of potato.

COMPOSITION.—The chief constituent is jalapin (*see* p. 446).

IMPURITIES.—Guaiacum resin, which blues potato. Jalap resin, insoluble in ether.

Dose, 3 to 8 gr.

Preparations.

1. **Pilula Scammonii Composita.**—Scammony resin, 1; resin of jalap, 1; curd soap, 1; tincture of ginger, 3. (The only official vegetable aperient pill not containing aloes.)

   Dose, 4 to 8 gr.

2. **Pulvis Scammonii Compositus.**—Scammony resin, 4; jalap, 3; ginger, 1.

   Dose, 10 to 20 gr.

Scammony resin also contained in Extractum Colocynthidis Compositum (1 in 6), Pilula Colocynthidis Composita (1 in 3), Pilula Colocynthidis et Hyoscyami (1 in $4\frac{1}{2}$).

ACTION.

Gastro-intestinal tract.—Scammony has no effect till it reaches the duodenum. With the bile it forms a **strongly purgative** compound, powerfully stimulating the intestinal glands and causing a profuse secretion of intestinal fluids. There is some exaggeration of vascularity, some irregular stimulation of the muscular coat, but these are comparatively slight, and there is little if any addition to the biliary flow. As a result of these actions, in about four hours there is a profuse **watery evacuation** of the bowels.

The drug is, therefore, a powerful **hydragogue cathartic**, and in large doses a strong gastro-intestinal irritant. Its action is attended with some griping. It produces no effect if injected into the blood, and therefore acts only locally on the intestine. It is anthelmintic to both round-worms and tape-worms.

THERAPEUTICS.

Scammony being a prompt purgative, obstinate constipation, in either children or adults, may be treated with it. It may also be given as an anthelmintic.

JALAP.

Jalapa.—Jalap. The dried tubercles of *Ipomœa purga* (Nat. Ord. *Convolvulaceœ*). Mexico.

CHARACTERS.—Irregularly ovoid or oblong, hard, compact roots. Size variable, generally somewhere between a walnut and hen's egg. May be in halves and quarters. Externally dark brown, furrowed, wrinkled with pale lines or scars. Internally dirty yellow or brown, with dark brown irregular circles. Odour smoky, slight. Taste sweetish, acrid, nauseous.

COMPOSITION.—The chief constituent is the official *resin.* The Pharmacopœia directs that Jalap should contain from 9 to 11 per cent. of the resin.

Dose, 5 to 20 gr.

Preparations.

1. **Extractum Jalapæ.** — Made with alcohol (90 per cent.) and water.

   Dose, 2 to 8 gr.

2. **Pulvis Jalapæ Compositus.**—Jalap, 5; acid tartrate of potassium, 9; ginger, 1.

   Dose, 20 to 60 gr.

3. **Tinctura Jalapæ.**—Jalap, 1; alcohol (70 per cent.), 5. Percolate. *Standardized to contain* 1·5 *per cent. of jalap resin.*

   Dose, ½ to 1 fl. dr.

Jalap is contained in Pulvis Scammonii Compositus, 3 in 8.

Jalapæ Resina.—Jalap Resin.

Source.—Jalap is digested and percolated with alcohol (90 per cent.). From the tincture thus formed the resin is precipitated with water. It is washed and dried.

Characters.—Dark brown, opaque, brittle fragments, translucent at the edges, breaking with a resinous fracture. Odour sweetish. Taste acrid. *Solubility.*—Readily in alcohol (90 per cent.), not in water. *Resembling jalap.*—Aloes, which is bitter.

Composition.—The chief constituents are—(1) *Convolvulin*, a glucoside, 18 per cent., a hard substance insoluble in ether, more irritant than jalapin, and probably the most active ingredient of jalap. (2) *Jalapin*, a glucoside, 18 per cent. Dose, ½ gr. This is a soft resinous substance, soluble in ether. It is probably the active principle of scammony. It is very doubtful whether jalap tubercles contain any jalapin, but it is found in jalap wood and jalap stalks. (3) Starch and gum.

Dose, 2 to 5 gr.

Jalap resin is contained in Pilula Scammonii Composita (1 in 6).

ACTION.

The mode of action of jalap is precisely the same as that of scammony, with only two exceptions. It causes a greater secretion of intestinal juice, and is therefore more hydragogue ; it stimulates the vessels and muscular coat less, and therefore is less irritant and griping.

THERAPEUTICS.

Jalap is very largely used as a hydragogue purgative when we want to draw off large quantities of fluid, therefore it is especially suitable for patients with Bright's disease, for those suffering from uræmia, and for those with dropsy from any cause. Large doses should not be given if the intestinal mucous membrane is liable to inflame easily. It is occasionally employed for severe constipation.

CROTON OIL.

Oleum Crotonis.—The fixed oil expressed from the seeds of *Croton tiglium* (Nat. Ord. *Euphorbiaceæ*). East Indies.

Characters.—Brownish yellow to dark reddish brown. Sp. gr. 0·95. Odour faint, peculiar, rancid. Taste oily, acrid. *Solubility.*—Freely in alcohol, ether, chloroform, or olive oil.

Composition.—The chief constituents are—(1) Several volatile acids (1 per cent. in all); these give the odour. (2) Tiglic or methyl crotonic acid, $C_5H_8O_2$. (3) Crotolinic acid, $C_9H_{14}O_2$. This appears to be the active principle. (4) Several fatty acids, both free and combined to form fats. (5) Crotonol, a substance which is non-purgative, but is capable of causing cutaneous irritation.

Dose, ½ to 1 m. on a lump of sugar, or mixed with butter or vaseline and placed at the back of the mouth, so that it may be quickly swallowed.

Preparation.

Linimentum Crotonis.—Croton oil, 1; oil of cajuput, 3½; alcohol (90 per cent.), 3½.

(Croton seeds are not official, but it is important to recognize them. They are ½ in. long, ⅓ in. broad, ovoid and bluntly oblong, covered with a brown shell, which on scraping becomes black. The kernel is white and oily. They yield 50 to 60 per cent. of croton oil. They are known from castor-oil seeds, which are like them, by the fact that the castor-oil seeds are bright, polished, and mottled.)

Action.

External.—Croton oil is one of the **most powerful irritants** in the pharmacopœia. A drop placed on the skin causes redness, burning pain, and quickly a crop of vesicles forms (vesication); these rapidly become **pustules** (pustulation), and the surrounding subcutaneous tissue is red and œdematous.

Internal.—*Gastro-intestinal tract.* Very soon after a drop has been taken there is considerable griping and abdominal pain. In an hour or two the bowels are opened, and this may subsequently occur several times, the motions becoming more and more fluid. The croton oil greatly aggravates the vascularity of the stomach and intestines, the mucous membrane of which becomes red, œdematous, and angry-looking; there is a great increase of the intestinal secretion, but none of the bile. The drug produces, in fact, severe **enteritis**, and to a less extent gastritis. The motions may contain blood. These effects are all due to the local effect of the croton oil. It is probable that the peristaltic movements are increased also; whether this is a result of the irritation, or of some action of the drug exerted after absorption, is not known. Croton oil applied to the skin may cause free purgation.

THERAPEUTICS.

External.—Croton oil was formerly employed externally as an irritant and counter-irritant for inflamed joints, pleurisy, bronchitis, phthisis, &c.; but it is not often so used now, as the scars left after the suppuration are very unsightly, the application is too painful, and the inflammation induced too severe. A little croton oil spread over an area not exceeding that of a sixpence may be applied to set up suppuration in the scalp, and so to destroy an inveterate patch of ringworm, if it is wished to cure it quickly. The croton oil will certainly do this, but the resulting suppuration is so severe that the remedy should be used with care, and only when all others have failed. The liniment, well diluted, is occasionally employed to stimulate the skin in alopecia.

Internal.—Croton oil should only be given in very obstinate constipation not due to organic obstruction, and only one dose should be administered. Not more than one or two drops should be prescribed. Constipation due to lead poisoning and fæcal impaction are sometimes suitable cases. Placed on the back of the tongue, it is, on account of its small bulk, a useful purgative for lunatics who refuse to take anything, and for unconscious patients, because in such cases it is quickly swallowed reflexly and therefore it is commonly given to those who are unconscious from apoplexy. It must never be administered to children, to pregnant women, to feeble subjects, to those with hæmorrhoids, nor to those suffering from peritonitis, gastritis, or enteritis.

COLOCYNTH PULP.

Colocynthidis Pulpa.—The dried pulp of the fruit of *Citrullus colocynthis*, freed from seeds. *Synonym.*—Bitter calumba (Nat. Ord. *Cucurbitaceæ*). Imported from Smyrna, Trieste, France, and Spain.

Characters.—More or less broken, whitish, very light, spongy, tough balls, about 2 in. in diameter, consisting of the pulp in which the seeds are embedded. The broken-up pulp without the seeds is alone official. This is light, spongy, whitish, odourless, with an intensely bitter taste.

Impurities.—Seeds and cortex.

Composition.—The chief constituents are—(1) *Colocynthin*, an amorphous or crystalline, bitter, active glucoside, readily soluble in water and alcohol. (2) Resinous matter having the names of citrullin, colocynthein, and colocynthitin, insoluble in water.

Preparations.

1. **Extractum Colocynthidis Compositum.**—Colocynth pulp, 6; extract of Barbados aloes, 12; resin of scammony, 4; curd soap, 4; cardamoms, 1; alcohol (60 per cent.), 160.
Dose, 2 to 8 gr.

2. **Pilula Colocynthidis Composita.**—Colocynth pulp, 1; Barbados aloes, 2; resin of scammony, 2; potassium sulphate, $\frac{1}{4}$; oil of cloves, $\frac{1}{4}$; water, q s.
Dose, 4 to 8 gr.

3. **Pilula Colocynthidis et Hyoscyami.**—Pilula colocynthidis composita, 2; extract of hyoscyamus, 1.
Dose, 4 to 8 gr.

Action.

In small doses colocynth acts as a simple bitter, increasing the gastric and intestinal secretions and improving the appetite. In larger doses it augments the flow of bile and succus entericus considerably, stimulates the muscular coat, causes a little griping, and leads to the evacuation of a **watery motion.** In still larger doses the hypersecretion is excessive and the griping is severe because the muscular coat is powerfully irritated, and several abundant watery motions result. The drug may therefore be called **drastic, hydragogue, and cathartic.** The depression produced may be considerable.

THERAPEUTICS.

Colocynth should never be given alone, because of the griping it causes. In the colocynth and hyoscyamus pill, which is often prescribed, the hyoscyamus prevents this painful result. Colocynth is an excellent purgative for producing a single abundant evacuation of the bowels in chronic constipation, such as that so often met with in persons suffering from hepatic disorder, and in those confined to bed. Because of the watery character of the motions it may be given in ascites or Bright's disease, but jalap or scammony is usually preferred. It is too irritant for habitual use. It should never be administered if there is any suspicion of intestinal or gastric inflammation, nor in pregnancy. It is often combined with milder purgatives. A diuretic action has been claimed for it, but this is unimportant.

ELATERIUM.

Elaterium.—A sediment of the juice of *Ecballium elaterium.* The Squirting Cucumber (Nat. Ord. *Cucurbitaceæ*).

CHARACTERS.—In light, friable, greenish-grey, flattened, or slightly incurved pieces, about $\frac{1}{10}$ in. thick. Odour faint, tea-like. Taste bitter, but should not be tasted, as it is so active.

IMPURITIES.—Starch, flour, chalk.

COMPOSITION.—The chief ingredient is *elaterin.*

The Pharmacopœia directs that elaterium should contain from 20 to 25 per cent. of elaterin.

Dose, $\frac{1}{10}$ to $\frac{1}{2}$ gr.

Elaterinum.—Elaterin. $C_{20}H_{28}O_5$. A neutral body, the active principle of elaterium.

CHARACTERS.—Small, colourless, hexagonal scales with a bitter taste (but never to be tasted). *Solubility.*—Not in water, sparingly in alcohol, easily in chloroform.

Dose, $\frac{1}{40}$ to $\frac{1}{10}$ gr.

Preparation.

Pulvis Elaterini Compositus.—Elaterinum, 1; sugar of milk, 39.

Dose, 1 to 4 gr.

ACTION.

The action of elaterium depends entirely on the elaterin. This is so powerful that if elaterium is prescribed it must be of the official strength. Elaterin is **violently purgative**, producing profuse watery evacuations attended with griping and much prostration. It acts like colocynth, and except that it is much more energetic the description of that drug will apply to it. It increases the salivary secretion. When injected subcutaneously it purges. It is the most powerful hydragogue purgative in the pharmacopœia.

THERAPEUTICS.

Elaterin should not be given in ordinary constipation, as it is too violent in its effects, but on account of the large amount of fluid it brings away it is in suitable cases very useful in ascites and in Bright's disease. The same cautions as were enumerated for colocynth are still more necessary here. It should not be given, or only with great care, in heart disease, on account of the depression produced.

GAMBOGE.

Cambogia.—Gamboge. A gum-resin obtained from *Garcinia Hanburii* (Nat. Ord. *Guttiferæ*). Imported from Siam.

CHARACTERS.—Cylindrical rolls, solid or hollow, longitudinally striated. Single or agglutinated into masses. Break with a smooth, conchoidal, glistening fracture. Reddish yellow, changing to yellow when rubbed with water. Taste acrid. Powder bright yellow.

COMPOSITION.—The chief constituents are—(1) A brilliant yellow resin, *gambogic acid*, 73 per cent. (2) Gum, 23 per cent. This is soluble, so that an emulsion of gambogic acid is formed with water.

IMPURITIES.—Starch, woody fibre.

Dose, $\frac{1}{2}$ to 2 gr.

Preparation.

Pilula Cambogiæ Composita.—Gamboge, 1; Barbados aloes, 1; compound powder of cinnamon, 1; hard soap, 2; syrup of glucose, 1.

Dose, 4 to 8 gr.

ACTION.

Gamboge is a **drastic hydragogue purgative,** causing much griping, and in large doses great irritation of the alimentary canal. Most of it passes in the fæces, but some is absorbed, causing the urine to be yellow. It is slightly diuretic.

THERAPEUTICS.

It is not often prescribed, as it is uncertain, and gripes considerably. It should never be given alone. It has been used as an anthelmintic.

CLASS IV.—**Cholagogues.**

PODOPHYLLUM.

Podophylli Rhizoma.—Podophyllum Rhizome. *Synonym.*—Podophyllin. The dried rhizome and roots of *Podophyllum peltatum*, the American May-apple (Nat. Ord. *Berberidaceæ*). Imported from North America.

CHARACTERS.—Pieces of variable length and about $\frac{1}{5}$ to $\frac{1}{3}$ in. thick, flattened, cylindrical, with irregular tuberosities, which are marked above by a depressed circular scar, and give off below a number of very brittle brownish rootlets, or show, if these are broken off, a corresponding number of whitish scars; externally dark reddish brown, smooth or wrinkled; fracture short; internally whitish and mealy or yellowish brown and horny. Odour faintly narcotic. Taste bitterish, acid, nauseous.

Composition.—The chief constituents are—(1) The alkaloid *beberine.* (2) The official *resin*, which is the purgative principle.

Podophylli Resina.—Podophyllum Resin.

Source.—Extract the root with alcohol (90 per cent.), and precipitate the resin with water acidulated with hydrochloric acid. Wash and dry.

Characters.—A pale yellow to deep orange-brown amorphous powder, soluble in alcohol and ammonia.

Composition.—Podophyllum resin contains at least two other resins, one soluble and the other insoluble in ether. These resins contain an active purgative crystalline body, podophylloxin. This, it is said, can be split up into picro-podophyllic acid, which is inert, and picro-podophyllin, a crystalline neutral body, the active principle. Both these also exist free in the rhizome.

Incompatibles.—Water precipitates it from alcohol, acids precipitate it from ammonia.

Dose, $\frac{1}{4}$ to 1 gr.

Preparation.

Tinctura Podophylli.—Resin of podophyllum, 320 gr.; alcohol (90 per cent.), 20 fl. oz. Macerate.

This contains twice the proportion of the resin in the tincture B. P. 1885.

Dose, 5 to 15 m.

Action.

External.—It has no external action unless applied to raw surfaces, from which it may be absorbed and then it will purge.

Internal.—*Gastro-intestinal tract.*—Podophyllum has a bitter taste. It is in large doses a powerful gastro-intestinal irritant, and has caused death. In medicinal doses it gives rise to much griping pain, perhaps some nausea, and in about ten hours there is an **evacuation of the bowels**; the motion, which is liquid, is deeply stained with bile. The pain shows that the muscular coat is stimulated, the liquidity that probably an excess of intestinal fluid is secreted, and the colour that more **bile** is poured into the intestine. In small doses podophyllum decidedly increases the secretion of bile, in purgative doses it does not, although more bile is poured from the gall-bladder into the intestine. It is thus a direct and indirect **cholagogue.** It probably acts after absorption, for all its effects can be produced if it is injected subcutaneously.

THERAPEUTICS.

Podophyllum is only used for its cholagogue purgative action. It is especially suitable for constipation due to hepatic disorder, whether functional, as in the hepatic dyspepsia which commonly goes by the name of biliousness, or organic, as in hepatic cirrhosis and cancer. It must be remembered that, as it causes much griping, it should be combined with hyoscyamus or some other drug to overcome this; that it takes a long while to act, and will therefore be swept away before it has produced any effect if given with quickly acting purgatives; and that it is better to begin with small doses, as people are very unequally affected by it. It may be advantageously combined with calomel in a pill. It is so disagreeable to the taste that it is better to dissolve the resin in aromatic spirits of ammonia (1 gr. to 1 fl. dr.) than to use the pharmacopœial tincture, as water does not precipitate the resin from ammonia, but it does from the pharmacopœial tincture.

EUONYMUS BARK.

Euonymi Cortex.—Euonymus Bark. The dried root-bark of *Euonymus atropurpureus*. *Synonyms.*—Wahoo, spindle-tree, hominy bush (Nat. Ord. *Celastrineæ*). United States.

CHARACTERS.—Incurved or quilled pieces, $\frac{1}{12}$ to $\frac{1}{8}$ in. thick. Colour light ash-grey with darker patches. Inner surface tawny white and smooth, when freed from fragments of white wood. Taste at first sweet, then bitter and acid.

COMPOSITION.—The chief constituents are (1) *euonymin*, a resin, (2) asparagin, and (3) euonic acid.

Preparation.

Extractum Euonmyi Siccum (commonly called euonymin).—Euonymus bark, 20 oz., is percolated with alcohol (45 per cent.); the liquid is evaporated till a brown dry powder is left, which is incorporated with a quarter of its weight of calcium phosphate, the object of which is to prevent it from agglutinating. It must be kept in a well-stoppered bottle.

Dose, 1 to 2 gr.

ACTION AND THERAPEUTICS.

In small doses euonymin stimulates the appetite and the flow of gastric juice. In larger it is irritant to the intestine and is cathartic. It increases the amount of bile excreted into the intestine. It has slight diuretic and expectorant effects, but it is only used as a purgative for those cases of constipation in which the liver is disordered.

Iridin.—(Not official.)

Synonym.—Irisin. The powdered extractive obtained from the root of *Iris versicolor*, the blue flag (Nat. Ord. *Iridaceæ*). Britain.

CHARACTERS.—A dark brown, bitter, nauseous powder.

Dose, 1 to 5 gr. in a pill with glycerine of tragacanth or extract of henbane.

ACTION AND THERAPEUTICS.

Iridin is a cholagogue, and as it rarely gripes it may be given when it is required to use a cholagogue purgative daily for some time. It may be combined with euonymin, calomel, podophyllin, and other cholagogue purgatives.

GROUP VI.

Volatile Oils.

These, when applied externally, stimulate the skin, and thus cause **redness**, sometimes even vesication, tingling, and subsequent numbness. Taken internally, they stimulate the gastro-intestinal tract, increasing its vascularity, the flow of saliva, of gastric juice, and of succus entericus ; and they excite its unstriped muscular fibres. Thus in moderate doses they are **stomachics** and **carminatives** ; in large doses they are gastro-intestinal **irritants.** Their irritation of the stomach reflexly stimulates the heart and the central nervous system. They are absorbed and excreted by the skin, which they may thus irritate, and by the bronchial mucous membrane, which they consequently stimulate, increasing the amount of secretion from it, its vascularity, the expulsive power of its unstriped muscle, and reflexly this irritation leads to coughing; consequently they are **expectorants.** They are also largely excreted by the kidneys, which are stimulated even to inflammation, and hence these drugs are often **diuretic** ; and by the **genito-urinary mucous membrane,** which is also stimulated, often so energetically that it becomes inflamed. Some volatile oils act strongly in all these ways ; others act much more powerfully in some than in others. They will be classified according to the tissue on which they chiefly act, or for the action for which they are mostly used.

Class I.—Volatile oils (or substances containing them) acting chiefly upon, or used chiefly for their stimulation of, the **skin.**

Oil of Turpentine, Wood Wool, Tar, Oil of Cade, Burgundy Pitch, Resin, Frankincense, Canada Balsam, Mustard, Cajuput Oil, Eucalyptus Oil, Oil of Rosemary, Arnica.

Class II.—Volatile oils (or substances containing them) acting chiefly upon, or used chiefly for their stimulation of, the **gastro-intestinal tract.**

Pyrethrum, Cloves, Pimento, Pepper, Nutmeg, Cinnamon, Horseradish, Capsicum, Ginger, Cardamoms, Sumbul, Oil of Lavender, Oil of Peppermint, Oil of Spearmint, Anise, Coriander, Fennel, Caraway, Dill, Elder Flowers, Chamomile, Rose.

Class III.—Volatile oils (or substances containing them) acting chiefly upon the stomach, so as to reflexly stimulate the **heart and central nervous systems,** or chiefly used for this purpose.

Valerian, Asafetida, Galbanum, Ammoniacum, Myrrh.

Class IV.—Volatile oils (or substances containing them) acting chiefly upon, or used chiefly for their stimulation of, the **bronchial mucous membrane.**

Terebene, Balsam of Peru, Balsam of Tolu, Storax, Firwool Oil, Grindelia.

CLASS V.—Volatile oils (or substances containing them) acting chiefly upon, or used chiefly for their stimulation of, the **kidneys and genito-urinary tract.**

Juniper, Buchu, Copaiba, Cubebs, Oil of Sanderswood.

CLASS I. OF **Volatile Oils.**

Those used chiefly for their action on the skin.

OIL OF TURPENTINE.

Oleum Terebinthinæ.—Oil of Turpentine. The oil distilled, usually by the aid of steam, from the oleo-resin (common turpentine) exuding from *Pinus sylvestris* and other species of *Pinus*. (Other common species are *P. australis* and *P. tæda*, America; *P. pinaster*, France; *P. sylvestris*, Russia); rectified if necessary. (All Nat. Ord. *Coniferæ*.)

CHARACTERS.—Limpid, colourless. Odour strong, peculiar. Taste pungent, bitter. Begins to boil at 320° F., and almost entirely distils below 356° F. Neutral. Mixes with other volatile and fixed oils. Dissolves resins (the solution forms varnish), wax, sulphur, phosphorus, and iodine. *Solubility.*—Not at all in water, 1 in 6½ of alcohol (90 per cent.), 3 in 10 of ether, and in all proportions in absolute alcohol, bisulphide of carbon, and chloroform. It is easily oxidized. Old oil of turpentine is an ozonizing agent; it readily absorbs oxygen, and becomes converted into an oleo-resin. French oil of turpentine is lævo-rotatory, some of it comes from *P. maritima*; English oil of turpentine, which mostly comes from America, and Russian oil of turpentine are dextro-rotatory.

COMPOSITION.—Oil of turpentine is a mixture of several isomeric hydrocarbons (terpenes), all having the formula $C_{10}H_{16}$. They vary in their boiling-points and the direction in which they rotate the plane of polarization. The principal terpene in American oil of turpentine is dextropinene; the principal terpene in French oil of turpentine is laevopinene. Most turpentine contains about 15 per cent. of oil of turpentine. Many official volatile oils, e.g. those of lavender, peppermint, chamomile, caraway, cloves, contain various terpenes, all isomeric, and all having the formula $C_{10}H_{16}$. An oxidation product of terpene is camphor, $C_{10}H_{16}O$, which is pharmacopœial (*see* p. 562). Sanitas, p. 460, is another product of the oxidation of a terpene.

Dose, 2 to 10 m., or 3 to 4 fl. dr. (anthelmintic).

1 fl. dr. of mucilage with thorough trituration emulsifies $\frac{1}{2}$ fl. dr. of oil of turpentine with 1 fl. oz. of water.

Preparations.

1. **Linimentum Terebinthinæ.**—Oil of turpentine, 13 ; camphor, 1 ; soft soap, $1\frac{1}{2}$; water, 5.
2. **Linimentum Terebinthinæ Aceticum.**—Oil of turpentine, 4 ; glacial acetic acid, 1 ; liniment of camphor, 4.

ACTION.

External.—Oil of turpentine has to a marked degree the action of other volatile oils. Thus, applied to the skin, especially if rubbed in, it causes the vessels to dilate, there is a sense of warmth, the part becomes red, and subsequently common sensation is blunted. This oil is therefore **rubefacient, irritant,** and **counter-irritant.** If enough is applied it is a vesicant. Like the other volatile oils it is **antiseptic** and **disinfectant.** It is absorbed by the unbroken skin.

Internal.—*Alimentary canal.*—Oil of turpentine has the same stimulant effect when locally applied to the mouth and pharynx as it has on the skin, and in the stomach it powerfully dilates the vessels, increases peristalsis and the gastric secretion, and **reflexly stimulates the heart,** but on account of its nauseous taste it is not used for these properties, which it has in common with other volatile oils. Its effects on the intestine are the same as those on the stomach, the most marked being its energetic stimulation of the muscular coats, hence it is a strong **carminative,** expelling gas from the bowels. If a large amount is given the excitation of the muscular coat leads to **purging,** the motions often containing much blood, hæmorrhage resulting from the great vascular dilatation. Oil of turpentine is **anthelmintic**, killing the tapeworm when administered in doses of 2–4 fl. dr.; but this treatment may cause severe symptoms. When given as an enema it kills the threadworm.

Circulation.—Oil of turpentine is readily absorbed. We do not know in what form it circulates. Statements concerning its action on the heart and vessels are very discordant, probably because different experimenters have used different varieties of oil of turpentine; but most specimens appear first to **stimulate the heart**, in some degree at least directly, for oil of turpentine locally applied will excite the excised heart, increasing the force and frequency of the cardiac beat. It contracts the vessels, and therefore it is a **hæmostatic**. The blood-pressure rises. After a large dose of any variety this stimulation is followed by depression, the heart beats feebly, the vessels dilate, and blood-pressure falls.

Respiration.—When inhaled, oil of turpentine acts on the bronchial mucous membrane as it does on the skin, irritating it, dilating the vessels, increasing and disinfecting the secretion, stimulating the muscles of the bronchi, and reflexly exciting cough. If given internally, as some of it is excreted by the bronchial mucous membrane, similar effects are produced. At the same time the activity of the respiratory movements is increased, so that the drug is a **powerful expectorant.**

Nervous system.—Oil of turpentine in large doses is a severe depressant to the nervous system, producing languor, dulness, sleepiness, and unsteady gait. Toxic doses cause coma and paralyse the sensory nerves; consequently reflex action is abolished.

Kidneys.—It acts more powerfully on these than almost any other volatile oil. Even moderate doses may lead to pain in the loins, scanty high-coloured urine, albuminuria, and **hæmaturia.** The **urinary** passages are also irritated, consequently, owing to muscular spasm, there is difficulty in passing water, micturition is painful, and a sensation of heat in the perinæum is present (these symptoms constitute strangury). If a large dose has been given the urine may be completely suppressed. Turpentine causes the urine to smell of violets.

Skin.—Oil of turpentine is excreted by the skin, and may cause an erythematous rash.

Some is probably excreted by the bile and intestinal mucous membrane.

It is said to be a mild antipyretic. Oil of turpentine is an antidote to phosphorus, and it is stated that old oil of turpentine and French oil of turpentine are preferable, but this is doubtful.

THERAPEUTICS.

External.—Oil of turpentine is very largely employed as an irritant or counter-irritant in various forms of chronic inflammation, such as osteoarthritis, bronchitis, or pleurisy. The liniments form useful applications. They may also be rubbed in over painful areas, as in neuralgia, myalgia, rheumatic pains, lumbago, &c. Sometimes it is used as a parasiticide for ringworm. Sanitas is an aqueous solution of common turpentine, which has been allowed to oxidize in the air. Its active antiseptic principle is peroxide of hydrogen (*see* p. 114), and it contains a little thymol. It is a very pleasant disinfectant, but is not so strong as carbolic acid.

Internal.—*Stomach and intestines.*—Oil of turpentine is not often prescribed for its carminative and stomachic effects, though given either by the mouth or as an enema it is often very efficacious in removing the intestinal distension due to gas. If it is used as an anthelmintic, 2–4 fl. dr. emulsified in mucilage and followed by a dose of castor oil should be given.

Sometimes it promptly relieves intestinal hæmorrhage, such as that due to typhoid fever. Whenever it is prescribed as a hæmostatic, considerable doses, 30 to 60 ♏, suspended in mucilage, should be administered every hour for a few hours.

Circulation.—It is not employed to influence this except as a hæmostatic. It has the reputation of being fairly efficacious in arresting hæmorrhage. It may be given in hæmoptysis, gastric ulcer, and other conditions attended with bleeding.

Respiration.—It is not much used as an inhalation, for the vapor of Oleum Pini (*see* p. 504) is pleasanter; but it might be employed to disinfect foul bronchial secretions, and to stimulate the mucous membrane in chronic bronchitis.

It should be remembered that oil of turpentine must be given internally with great care because of its liability to cause inflammation of the kidneys; indeed, this fact and its nasty taste account for its not being so often administered as would otherwise be the case. It should never be given to the subjects of Bright's disease.

Wood Wool.—(Not official.)

This is finely comminuted pine wood rendered antiseptic with corrosive sublimate.

Action and Therapeutics.

It is very absorbent, is used for dressing wounds, and is very popular in the form of diapers (sanitary towels) for use during menstruation or uterine discharges, or after delivery. It is also used for infants' napkins.

TAR.

Pix Liquida.—Wood Tar. A bituminous liquid obtained from the wood of *Pinus sylvestris*, and other species of *Pinus* (Nat. Ord. *Coniferæ*), by destructive distillation Known in commerce as Stockholm tar.

CHARACTERS.—Brownish-black semi-liquid substance. Odour peculiar, aromatic. Water shaken with it acquires a pale brown colour, empyreumatic taste, and acid reaction. *Solubility.*—1 in 10 of alcohol (90 per cent.), slightly in oil of turpentine or olive oil, 1 in 3 of a solution of caustic soda. On distillation it gives off an empyreumatic oil (oil of tar), which is official in the United States, and pyroligneous acid. What remains behind is pitch. This is black, solid, melting in boiling water.

COMPOSITION.—Tar is a very complex substance. The chief constituents are—(1) *Oil of turpentine* (*see* p. 457). (2) *Creosote* (*see* p. 296). (3) Phenols (*see* p. 290). (4) Pyrocatechin (*see* p. 527). (5) Acetic acid. (6) Acetone. (7) Xylol. (8) Toluol. (9) Methylic acid. (10) Resins.

Dose, 20 to 60 m. in the form of pills.

Preparation.

Unguentum Picis Liquidæ.—Tar, 5; yellow beeswax, 2.

Pix Carbonas Preparata.—Prepared coal tar.

SOURCE.—Commercial coal tar is stirred and heated at 120° F. for 1 hour.

COMPOSITION.—It contains chiefly—(1) Benzene and homologous hydrocarbons. (2) Phenols. (3) Solid hydrocarbons, as naphthalene and anthracene.

Preparation.

Liquor Picis Carbonis.—Quillaia bark, 2 oz., is percolated with alcohol (90 per cent.), 20 fl. oz. To the percolate is added prepared coal tar, 4 oz. When in prescribing water is added to this solution of tar the quillaia helps to suspend the precipitated tar.

ACTION.

External.—Tar has precisely the same actions as oil of turpentine, but is not so powerful, therefore the vascular dilatation rarely proceeds to the stage of vesication; but pustules may result if the tar is rubbed in.

Internal.—It is very liable to upset digestion; in large doses it causes epigastric pain, vomiting, severe headache, dark urine, and other symptoms of carbolic acid poisoning (*see* p. 295). Some of its constituents are excreted by mucous membranes, especially the bronchial, on which it acts as a disinfectant stimulating expectorant.

THERAPEUTICS.

External.—Tar ointment, which is rather hard, and may be softened by replacing half the wax with almond oil, is often applied as a stimulant to chronic skin diseases, such as psoriasis and chronic eczema. Because of its mildly anæsthetic action, it is sometimes useful in pruritus.

Liquor Picis Carbonis is a favourite preparation for many skin diseases. It is an imitation of the popular Liquor Carbonis Detergens which is an alcoholic solution of ordinary coal tar.

Internal.—Coal tar is rarely prescribed for internal use. Wood tar is only given as an expectorant, and it is very valuable for chronic bronchitis. It may be prescribed as a pill or as the United States Syrupus Picis Liquidæ (dose 1 to 4 fl. dr.), or as Vinum Picis (a saturated solution of wood tar in sherry, dose 1 to 4 fl. dr.), or as the French preparation eau de goudron. Tar water is made by stirring a pint of wood tar with half a gallon of water for fifteen minutes and decanting. The dose is a pint daily. It may be used externally as a wash. The Syrup of Tar with Syrup of Virginian Prune (*see* p. 409) and $\frac{1}{20}$ gr. of Apomorphine hydrochloride forms an excellent cough mixture.

OIL OF CADE.

Oleum Cadinum.—*Synonyms.*—Huile de cade, Juniper tar oil. An empyreumatic oily liquid obtained by the destructive distillation of the woody portions of *Juniperus oxycedrus* (Nat. Ord. *Coniferæ*) and other species.

CHARACTERS.—An empyreumatic, dark reddish-brown, viscid, oily liquid. Odour smoky, tar-like. Taste aromatic.

Sp. gr. 0·99. *Solubility.*—Freely in ether and chloroform, partly in alcohol, not in water. Mixes readily with fats and fixed oils.

COMPOSITION.—Probably much the same as that of tar.

ACTION AND THERAPEUTICS.

Oil of cade has the same action on the skin as tar, but it is preferable, as the odour is pleasanter. The diseases treated by the application of it are psoriasis, chronic eczema, and pruritus. A usual formula is oil of cade 1, soft soap 4, alcohol (90 per cent.) 4. Or an ointment may be made by melting it with an equal part of yellow wax.

BURGUNDY PITCH.

Pix Burgundica.—The resinous exudation from the stem of *Picea excelsa*, the spruce fir (Nat. Ord. *Coniferæ*), melted and strained. Austria.

CHARACTERS.—Hard and brittle, yet gradually adapting itself to the form of the vessel in which it is contained. Opaque, dull reddish or yellowish brown, fracture clear and conchoidal. Odour agreeable, aromatic, especially when heated. Taste sweet, aromatic. Readily soluble in glacial acetic acid.

IMPURITIES.—Palm oil, resin, and water, detected by not being soluble in glacial acetic acid.

COMPOSITION.—The chief constituents are pimaric acid and a volatile oil.

Preparation.

Emplastrum Picis.—Burgundy pitch, 26; frankincense, 13; resin, $4\frac{1}{2}$; yellow beeswax, $4\frac{1}{2}$; olive oil, 2; water, 2.

ACTION AND THERAPEUTICS.

Pitch is used as a basis for plasters. It is mildly stimulant to the skin.

RESIN.

Resina.—*Synonym.*—Rosin. The residue left after distillation of oil of turpentine from the crude oleo-resin (turpentine) of various species of *Pinus* (Nat. Ord. *Coniferæ*).

Characters.—Translucent, yellowish, brittle, pulverisable. Fracture shining. Odour and taste like turpentine. Burns with a yellow flame and much smoke. Soluble in alcohol, ether, alkalies, and carbon bisulphide.

Composition.—The chief constituent is abietic acid $C_{18}H_{27}\cdot COOH$, a crystalline substance.

Preparations.

1. **Emplastrum Resinæ.**—Resin, 2; lead plaster, 16; hard soap, 1.
2. **Unguentum Resinæ.**—Resin, 8; yellow beeswax, 8; olive oil, 8; lard, 6.

Resin is contained in many plasters.

Action and Therapeutics.

Resin is antiseptic and slightly stimulant, and is, therefore, an excellent application for indolent ulcers, sores, and wounds. Resin soap, formed by boiling together in an evaporating dish for two hours 1800 gr. of resin, 300 gr. of caustic soda, and 1 pint of water, separating the soap by a strainer, and drying on a water-bath, may be used as an emulsifying agent, but the taste is very disagreeable.

FRANKINCENSE.

Thus Americanum.—Frankincense. The concrete oleo-resin scraped off the trunks of *Pinus palustris* and *Pinus tæda* (Nat. Ord. *Coniferæ*). Southern United States.

Characters.—When fresh it is a soft, yellow, opaque, tough solid, becoming darker, dry, and brittle by keeping. Odour and taste as of turpentine.

Composition.—It is an oleo-resin.

Frankincense is contained in Emplastrum Picis.

Action and Therapeutics.

Frankincense is used for the same purposes as resin (*see* above).

CANADA BALSAM.

Terebinthina Canadensis.—Canada Turpentine, or Canada Balsam. The oleo-resin obtained from *Abies balsamea* (Nat. Ord. *Coniferæ*). Canada.

Characters.—It is pale yellow, faintly greenish, transparent, fluid, of the consistency of thin honey. Odour peculiar, agreeable. Taste slightly bitter. It slowly dries, forming a transparent varnish. Readily soluble in ether, chloroform, or spirit.

Composition.—It is an oleo-resin, and contains oils and resins isomeric with those of ordinary turpentine and resin.

Canada balsam is contained in Collodium Flexile.

Action and Therapeutics.

Canada balsam is rarely used except for its physical property of drying to form an adhesive varnish. It has the same action as oil of turpentine.

MUSTARD.

Sinapis Albæ Semina.—White Mustard Seeds. The dried ripe seeds of *Brassica alba* (Nat. Ord. *Cruciferæ*).

Characters.—About $\frac{1}{12}$ in. in diameter, roundish, pale yellow, very finely pitted, hard; internally yellow oily. Inodorous. Taste pungent.

Composition.—The chief constituents are—(1) A bland fixed oil. (2) *Sinalbin* and *myrosin;* the latter is an enzyme, and in contact with water converts sinalbin, which is a glucoside, into a fixed pungent body called acrinyl isothiocyanate, glucose, and sinapin sulphate.

Sinapis Nigræ Semina.—Black Mustard Seeds. The dried ripe seeds of *Brassica nigra* (Nat. Ord. *Cruciferæ*).

Characters.—Scarcely half the size of white mustard seeds. Roundish, dark reddish or greyish brown, finely pitted, hard; yellow internally. Inodorous if dry even when powdered, but when rubbed with water yielding a strong pungent odour and irritating the eyes. Taste very pungent. *Resembling black mustard seeds.*—Colchicum seeds, which are larger, lighter, and not quite globular.

Composition.—The chief constituents are—(1) The same fixed oil as the white seeds, about 35 per cent. (2) *Sinigrin* (which is potassium myronate $C_{10}H_{18}KO_{10}NS_2$, a potassium salt of myronic acid, which is a crystalline glucoside) and *myrosin,* an enzyme which on contact with water converts sinigrin into the official volatile oil of mustard (C_3H_5NCS, which is allyl isothiocyanate), glucose, and potassium hydrogen sulphate. The volatile oil is very pungent, and its development on the addition of water explains the pungency of ordinary mustard.

Oleum Sinapis Volatile.—Allyl Isothiocyanate. C_3H_5NCS. The volatile oil distilled from black mustard seeds after maceration with water.

Characters.—Pale yellow or colourless; intensely pungent and irritant. Sp. gr. 1·018 to 1·030. *Solubility.*—1 in 50 of water, readily in spirit and in ether.

Preparation.

Linimentum Sinapis.—Volatile oil of mustard, 2; camphor, 3; castor oil, 7; alcohol (90 per cent.), 43.

Sinapis.—Black and white mustard seeds powdered and mixed.

Characters.—A greenish-yellow powder, of an acrid, bitterish, pungent taste; odourless when dry, but exhaling when moist a characteristic pungent odour, and very irritating to the nostrils and eyes.

Impurities.—Starch and flour.

Preparation.

Charta Sinapis.—Extract the fixed oil from bruised mustard seeds with benzol. Dry and powder the residue. Mix 75 grains of it with 5 fl. dr. of the Liquor Caoutchouc and spread on one side of 30 square inches of cartridge paper.

Action of Mustard.

External.—Mustard is a typical powerful local **irritant.** Thus it first produces dilatation of the vessels, which causes redness of the skin (**rubefacient** effect) and a sensation of **warmth.** Because of the irritant action of mustard on the sensory nerves, a severe **burning** pain is soon felt. This irritation of the nerves is followed by their paralysis, consequently there is a local **loss of sensibility,** and a diminution both of the pain produced by the mustard and of any that may have been present before its application. The irritation of the vessels leads to the transudation of plasma through them; this, collecting under the epidermis, raises it, and thus **vesicles**, blebs, or blisters are formed (vesicant effect). Mustard is also a **counter-irritant** (*see* p. 51): that is to say, the stimulation of the cutaneous nerves reflexly leads to an alteration in the size of the vessels of the viscera under the seat of application.

This excitation of the sensory nerves is sufficiently powerful to **reflexly stimulate the heart and respiration**, and sometimes to restore consciousness after fainting.

Internal.—*Gastro-intestinal tract.*—Mustard also acts here as an irritant. Taken in the usual small quantities as a condiment, it causes a sense of warmth in the stomach, it moderately **stimulates** the secretion of gastric juice and the peristaltic movements, and therefore sharpens the appetite. A dose of one to four teaspoonfuls stirred up in a tumbler of water is sufficiently irritating to be a direct stomachic **emetic**, causing prompt vomiting without the depression which usually attends emetics, because the mustard reflexly stimulates the heart and respiration.

THERAPEUTICS.

External.—A poultice made with linseed and having a little mustard sprinkled on it is a very common and efficacious application as an irritant and counter-irritant in rheumatism, pleurisy, pneumonia, bronchitis, pericarditis, and many inflammatory diseases. In the manner already explained it will, when applied to the skin, soothe pain in gastralgia, colic, painful diseases of the chest, neuralgia, lumbago, &c. The paper or any of the mustard leaves that are sold, moistened in water, form an excellent application. Often the local application of mustard over the stomach relieves vomiting. A large mustard poultice applied to the legs was formerly used as a reflex stimulant in cases of syncope, asphyxia, and coma.

Common colds and febrile conditions, especially in children, are often treated by placing the feet and legs or the whole body in mustard and warm water (10 to 15 ounces of mustard to every 15 gallons of water, as hot as can be borne), the object being by the cutaneous dilatation to withdraw blood from the inflamed part. A mustard sitz bath may be taken at the period to induce menstruation.

Internal.—Mustard is used as a condiment, and also as an emetic. It is especially valuable for poisoning by narcotics, because of its reflex stimulant effects.

CAJUPUT OIL.

Oleum Cajuputi.—The oil distilled from the leaves of *Melaleuca leucodendron* (Nat. Ord. *Myrtaceæ*). Imported from Batavia and Singapore.

CHARACTERS.—A transparent, very volatile, limpid, pale bluish-green liquid, with a strong, penetrating, camphoraceous odour. Taste warm, bitter, aromatic, camphoraceous, and succeeded by a sensation of coldness. Floats on water. Sp. gr. 0·922 to 0·930. Readily soluble in alcohol.

COMPOSITION.—The chief constituents are—(1) Hydrate of cajuputene, isomeric with Borneo camphor (*see* p. 563), 75 per cent. (2) Another oil.

IMPURITIES.—Copper and other oils.

Dose, $\frac{1}{2}$ to 3 m.

Preparation.

Spiritus Cajuputi.—Oil of cajuput, 1; alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885.

Oil of cajuput is contained in Linimentum Crotonis.

ACTION.

The action of cajuput oil is exactly the same as that of the oil of cloves (*see* p. 475).

THERAPEUTICS.

External.—Cajuput oil is used as a stimulant, irritant, and counter-irritant—usually diluted with sweet oil—for all sorts of purposes when any of these effects are needed. Thus it is rubbed in for chilblains, myalgia, rheumatic pains, chronic inflammatory conditions of the joints or periosteum. It has also been employed as a parasiticide for *Tinea tonsurans*. The only objection to its use is its strong smell.

Internal.—It is occasionally given in dyspepsia, usually combined with other remedies, for the sake of its carminative, stomachic, and antispasmodic effects; it may be taken on sugar.

OIL OF EUCALYPTUS.

Oleum Eucalypti.—The oil distilled from the fresh leaves of *Eucalyptus globulus*, the blue gum tree (Nat. Ord. *Myrtaceæ*), and probably other species of *Eucalyptus*. Imported from Australia.

CHARACTERS.—Colourless or pale straw-coloured, becoming darker and thicker by exposure. Odour aromatic. Taste spicy, pungent, leaving a sensation of coldness in the mouth. Neutral. Sp. gr. 0·910 to 0·930. *Solubility.*—In an equal weight of alcohol. The oils from different species of *Eucalyptus* vary very much.

COMPOSITION.—The chief constituents are—(1) A volatile oil, *eucalyptol*, about 70 per cent. It is that portion which in distillation passes over between 330° and 352° F. It is a mixture of (*a*) a terpene called phellandrene, $C_{10}H_{16}$, and (*b*) cymene, $CH_3{\cdot}C_6H_4{\cdot}CH(CH_3)_2$ (*see* p. 491). It is met with in commerce. (2) A crystallizable resin, probably derived from the oil, and yielding ozone. (3) Tannin. (4) An oil isomeric with hydrate of cajuputene (*see* p. 469). It is met with in commerce, and is called crystallizable eucalyptol, as it solidifies at 32° F.

INCOMPATIBLES.—Alkalies, mineral acids, metallic salts.

Dose, ½ to 3 m.

Preparation.

Unguentum Eucalypti.—Oil of eucalyptus, 1; white soft paraffin, 5; hard paraffin, 4.

ACTION.

External.—Oil of eucalyptus is much less irritant when applied externally than other volatile oils, but if its vapour is confined it will produce vesication and pustulation. It is powerfully **antiseptic** and **disinfectant.** Old oil is more antiseptic than new, probably from the greater amount of ozone it contains.

Internal.—*Gastro-intestinal tract.*—In medicinal doses oil of eucalyptus is stomachic, having the same actions as oil of cloves. In large doses it produces severe gastro-intestinal irritation, as shown by vomiting, diarrhœa, and abdominal pain.

Circulation.—It, like **quinine**, arrests the movements of the white blood-corpuscles ; and it likewise resembles this drug in its antipyretic and its antiperiodic actions, and also, it is said, in causing contraction of the spleen ; but quinine is in all respects the more energetic. In medicinal doses the heart is stimulated by oil of eucalyptus, and the blood-pressure rises ; probably these effects are reflex from the stomach. After large quantities the action of the heart is enfeebled, and temperature falls.

Respiration.—Small doses slightly accelerate, poisonous doses slow, respiration.

Nervous system.—Large doses are powerfully depressant to the brain, to the medulla, and to the spinal cord, abolishing reflex action. Death occurs from paralysis of respiration.

Mucous membranes, kidneys, and skin.—Like other volatile oils, eucalyptus is excreted by all these channels. It imparts its odour to, and disinfects, the breath and the urine. It stimulates the organs by which it is excreted, consequently it is a diaphoretic, a stimulating expectorant, a diuretic, and a stimulant to the genito-urinary tract. Large doses cause renal congestion.

THERAPEUTICS.

External.—It is used as an antiseptic for wounds, sores, and ulcers. It is three times as powerful as carbolic acid, and is therefore preferred by some surgeons. A eucalyptus gauze has been prepared as a dressing for wounds, which may be washed with a weak solution of the oil in alcohol. An ointment of eucalyptus oil 8 pts., iodoform 1 pt., hard paraffin and vaseline 40 pts. of each is applied to chancres. An emulsion of the oil is used as a urethral injection. It would probably be an efficient parasiticide.

Internal.—A vapour or a spray of oil of eucalyptus has been recommended for diphtheria and foul bronchitis, and it is somctimes given by the mouth to correct the fœtor of the expectoration. Occasionally it is used for its stomachic, carminative effects, especially if the fæces are very foul-smelling, and some employ it in cystitis and pyelitis. It has been prescribed in septicæmia. As an antiperiodic for ague and an antipyretic it is far inferior to quinine.

OIL OF ROSEMARY.

Oleum Rosmarini.—The oil distilled from the flowering tops of *Rosmarinus officinalis* (Nat. Ord. *Labiatæ*).

CHARACTERS.—A colourless or pale yellow volatile oil. Odour of rosemary. Taste warm, aromatic. Sp. gr. 0·90 to 0·915.

COMPOSITION.—The chief constituent is a terpene.

Dose, ½ to 3 m.

Preparation.

Spiritus Rosmarini.—Oil of rosemary, 1 alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885.

Oil of rosemary is contained in Linimentum Saponis and Tinctura Lavandulæ Composita.

ACTION AND THERAPEUTICS.

Oil of rosemary has an action similar to that of other aromatic volatile oils. It is very commonly used to give a pleasant scent to hair lotions and other preparations which are used externally.

ARNICA.

Arnicæ Rhizoma.—Arnica Rhizome. The dried rhizome and rootlets of *Arnica montana* (Nat. Ord. *Compositæ*). Middle and Southern Europe.

CHARACTERS.—1 to 2 in. long, $\frac{1}{6}$ to $\frac{1}{4}$ in. in diameter cylindrical, dark brown, contorted, rough. Remains of leaves at upper end, wiry rootlets from the lower surface. Odour peculiar, aromatic. Taste acrid, bitter. *Resembling arnica.*—Valerian and Serpentary, each having characteristic odour.

COMPOSITION.—The chief constituents are—(1) A volatile oil. (2) Arnicin $C_{12}H_{22}O_2$ the active principle. (3) Inulin, and a resin.

Preparation.

Tinctura Arnicæ.—Arnica root, 1; alcohol (70 per cent.), 20. Percolate.

ACTION AND THERAPEUTICS.

The action of arnica is the same as that of volatile oils generally. Externally the tincture is used as an application to bruises, but it is very doubtful how far its good effects are owing to the spirit, and how far to any increase of cutaneous vascularity due to the volatile oil of the arnica.

It is rarely given internally, but in small doses it is a stomachic, a carminative, and a reflex stimulant, and in larger doses causes vomiting and purging. It is excreted by the kidneys and mucous membranes, and has been credited with obscure effects on the central nervous system.

MEZEREON BARK.

Mezerei Cortex.—The dried bark of *Daphne mezereum, Daphne laureola* or *Daphne gnidium* (Nat. Ord. *Thymelaceæ*). Britain.

Characters.—Long, thin, flattened strips, usually rolled into small quills. Externally covered by a brown corky layer. Internally whitish, silky, very tough.

Composition.—The chief constituent is a soft, brown vesicant resin.

Mezereon Bark is contained in Liquor Sarsæ Compositus Concentratus.

Action and Therapeutics.

Mezereon bark is a rubefacient and vesicant externally, and internally it is a gastric stimulant.

Class II. of **Volatile Oils.**

Those used chiefly for their action on the gastro-intestinal tract.

PYRETHRUM.

Pyrethri Radix.—Pyrethrum. *Synonym.*—Pellitory root. The dried root of *Anacyclus pyrethrum* (Nat. Ord. *Compositæ*). Levant.

Characters.—Unbranched pieces, 2-4 in. long, $\frac{1}{2}$-$\frac{3}{4}$ in. in diameter. Bark thick, brown, shrivelled; studded by dark-coloured receptacles for the resin. Close fracture, showing radiate surface. Inodorous. Causes a pricking sensation in the mouth when chewed. *Resembling pyrethrum.*—Taraxacum, which is darker, and has not a burning taste.

Composition.—The chief constituents are—(1) Volatile oils and resins. (2) Inulin.

Preparation.

Tinctura Pyrethri.—Pyrethrum, 1; alcohol (70 per cent.), 5. Percolate.

Action and Therapeutics.

Pyrethrum is a powerful sialogogue, and causes a burning sensation in the mouth, followed by numbness and tingling. Small quantities give a pleasant taste to tooth powders.

CLOVES.

Caryophyllum.—Cloves. The dried flower-buds of *Eugenia caryophyllata* (Nat. Ord. *Myrtaceæ*). Penang, Bencoolen, and Amboyna.

Characters.—Over ½ in. long, consisting of a dark brown, wrinkled, subcylindrical, and somewhat angular calyx tube, which tapers below and is surmounted by four teeth, between which the paler coloured petals, enclosing the numerous stamens and style, are rolled up in the form of a ball. Odour strong, fragrant, and spicy. Taste very pungent and aromatic. It emits oil when indented.

Composition.—The chief constituents are—(1) *Oleum Caryophylli* 18 per cent. (see below). (2) Eugenin, a crystalline body. (3) Caryophyllin, a neutral body isomeric with camphor.

Preparation.

Infusum Caryophylli.—1 in 40 of boiling water. **Dose, ½ to 1 fl. oz.**

Cloves are contained in Infusum Aurantii Compositum.

Oleum Caryophylli.—Oil of Cloves. The oil distilled from cloves.

Characters.—Colourless when recent, becoming yellowish and then brown. Taste and odour like cloves. Easily soluble in spirit or ether. Sp. gr. 1·050–1·065.

Composition.—The chief constituents are—(1) *Eugenol* (*synonym*, Eugenic acid), $C_{10}H_{12}O_2$, which chemically resembles phenol, and forms permanent salts with alkalies. (2) A hydrocarbon $C_{15}H_{24}$.

Dose, ½ to 3 m.

Oil of cloves is contained in Pilula Colocynthidis Composita, and Pilula Colocynthidis et Hyoscyami.

Incompatibles.—Lime water, salts of iron, mineral acids, and gelatine.

Action of Cloves and Oil of Cloves.

Oil of cloves is a typical example of a volatile oil the most important actions of which are exerted in the stomach.

External.—When rubbed into the skin it is stimulant, rubefacient, irritant, and counter-irritant, and gives rise to considerable vascular dilatation. At first it causes a sensation of **tingling** and pain, which afterwards is replaced by local **anæsthesia.** It is a parasiticide and antiseptic.

Internal.—*Mouth.*—In the mouth oil of cloves produces the same effects as on the skin ; there is a burning sensation accompanied by vascular dilatation and an increased flow of saliva, and followed by local anæsthesia. Cloves stimulate the nerves of taste, and being volatile and aromatic, those of smell also ; by both these means taste is sharpened.

Stomach.—The stimulant effect of cloves is experienced here. The **vessels** are **dilated, peristalsis** is **accelerated,** the secretion of **gastric juice** is **excited,** and as cloves are pleasant and aromatic, they do not ordinarily produce nausea ; consequently the **appetite** is **increased.** The combined effect of these actions is to aid digestive processes—therefore oil of cloves is **stomachic** ; and to facilitate the expulsion of gas—thus it is **carminative.** The stimulation of the gastric nerves to a slight extent reflexly affects the heart in the same way as alcohol ; therefore the **rate and force of the pulse** are moderately **increased.**

Intestines.—Here likewise oil of cloves dilates the vessels, and stimulates the secretion and the muscular coat of the intestine, consequently colicky pains due to irregular contraction of it are relieved, and flatus is expelled.

Circulation.—Oil of cloves is readily absorbed from the intestine, circulates in the blood, and is said to increase the number of white corpuscles. It may to a slight extent stimulate the heart directly, but the greater part of the stimulation of the heart excited by it is reflex from the stomach. It is credited with the power of arresting painful spasmodic contractions in various parts of the body. It can, as we have seen, do this in the intestine, and possibly it may have to a slight extent the same action in the bronchial tubes, heart, &c. This causes it to be called **antispasmodic.**

Mucous membranes.—Like other volatile oils it is excreted by the kidneys, skin, bronchi, and genito-urinary tract, and in passing through these structures will act as a **stimulating disinfectant** to their secretion; but oil of cloves is never used for these purposes.

THERAPEUTICS OF CLOVES AND OIL OF CLOVES.

External.—Oil of cloves is too dear for frequent external application, but on account of its local anæsthetic effect it has been used for neuralgia. It is employed to give a pleasant scent to liniments.

Internal.—The oil is sometimes dropped into decayed teeth to relieve pain. Cloves are frequently employed in cookery for their taste, and because they stimulate the appetite and aid digestion. The oil or the infusion may be used medicinally as a stomachic, as a carminative, as an antispasmodic, or to relieve colicky pains in indigestion. It will have been noticed that oil of cloves is present in the two pills containing colocynth. This is to prevent the griping this purgative might otherwise cause.

PIMENTO.

Pimenta.—Pimento. The dried, full-grown unripe fruit of *Pimenta officinalis*, the allspice tree (Nat. Ord. *Myrtaceæ*). West Indies.

CHARACTERS.—Dry, light, roundish, $\frac{1}{5}$ in. or more in diameter, crowned with the remains of the calyx in the form of a raised scar-like ring; pericarp roughish, from the presence of oil-glands; brittle, dark brown, two-celled, each cell containing a brownish-black, somewhat compressed, reniform seed. Odour and taste like cloves. *Resembling pimento.*—Pepper, which has no calyx; cubebs, which is stalked.

COMPOSITION.—The chief ingredient is a volatile oil. It is chemically the same as that found in cloves. It is official (*see* p. 478).

Preparation.

Aqua Pimentæ.—Distilled from a mixture of pimento, 1; water, 40.

Dose, 1 to 2 fl. oz.

Oleum Pimentæ.—The oil distilled from the frui of *Pimenta officinalis.*

Characters.—It is yellow, but becomes brown by keeping. Sp. gr. 1·04.

Dose, ½ to 3 m.

Action and Therapeutics.

The actions and uses of pimento and its oil are precisely the same as those of cloves and oil of cloves.

BLACK PEPPER.

Piper Nigrum.—The dried unripe fruit of *Piper nigrum* (Nat. Ord. *Piperaceæ*). East Indies.

Characters.—Globular, ⅕ in. in diameter. Thin, blackish brown, pericarp containing a hard, smooth, roundish, yellowish-brown or grey seed. Odour aromatic. Taste pungent. *Resembling black pepper.*—Pimento, which has a calyx; cubebs, which is stalked.

Composition.—The chief constituents are—(1) An oleoresin, readily yielding a volatile oil with the odour of pepper, and a resin. (2) Piperine, $C_{17}H_{19}NO_3$, a pale yellow crystalline alkaloid, isomeric with morphine. (3) Piperidine, $C_5H_{11}N$, a neutral principle.

Dose, 5 to 20 gr.

Preparation.

Confectio Piperis.—Pepper, 2; caraway, 3; clarified honey, 15.

Dose, 60 to 120 gr.

Black pepper is contained in Pulvis Opii Compositus.

Action.

Pepper, because of its volatile oil, acts like other substances containing volatile oils; thus externally it is at first rubefacient and counter-irritant, and subsequently it acts as an anodyne. Internally it increases the secretions of the mouth, and in the stomach it is stomachic and carminative. During its excretion it stimulates the mucous membrane of the genito-urinary tract. Piperine is believed to be a feeble antipyretic and antiperiodic.

THERAPEUTICS.

Occasionally pepper is used externally as an irritant for the same class of cases as mustard. Internally it may be employed, in the form of a gargle, as a stimulant for relaxed conditions of the throat. It is taken in the form of a condiment for its stomachic properties. The confection or pepper lozenges are given empirically to relieve hæmorrhoids, ulcers of the rectum, and fissures of the anus.

NUTMEG.

Myristica.—Nutmeg. The dried seed of *Myristica fragrans* (Nat. Ord. *Myristicaceæ*) divested of its testa. Malay Archipelago.

CHARACTERS.—Ovoid, about 1 in. long. Externally greyish brown, with reticulated furrows. Internally greyish red, marbled with brownish-red veins. Odour aromatic. Taste warm, bitter, aromatic.

COMPOSITION.—The chief constituents are—(1) The fixed *concrete oil*, 25–30 per cent. which consists of Glyceryl oleate, Glyceryl butyrate and Glyceryl myristate. (2) The official *volatile oil*, 2–8 per cent. (*see* below).

Nutmeg is contained in Pulvis Catechu Compositus, Pulvis Cretæ Aromaticus, Spiritus Armoraciæ Compositus, and Tinctura Lavandulæ Composita.

Oleum Myristicæ.—Volatile oil of nutmeg. The oil distilled from nutmegs.

CHARACTERS.—Colourless or pale yellow. Odour and taste of nutmeg. Sp. gr. 0·87 to 0·91.

COMPOSITION.—The chief constituents are—(1) Myristicene, $C_{10}H_{16}$, a terpene. (2) Myristicol, $C_{10}H_{14}O$.

Dose, ½ to 3 m.

Preparation.

Spiritus Myristicæ.—Oil of nutmeg, 1 ; alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885.

Oil of nutmeg is contained in Pilula Aloës Socotrinæ, Tinctura Guaiaci Ammoniata, Tinctura Valerianæ Ammoniata, and Spiritus Ammoniæ Aromaticus.

Spiritus Myristicæ is contained in Mistura Ferri Composita.

ACTION AND THERAPEUTICS.

The action of oil of nutmeg is the same as that of other aromatic oils. Nutmegs are much employed in cookery for the sake of their volatile oil, which is an agreeable stomachic. A Linimentum Myristicæ, containing one part of expressed oil of nutmeg to three of olive oil, is an elegant antiparasitic for mild cases of ringworm.

CINNAMON.

Cinnamomi Cortex.—The dried inner bark of shoots from the truncated stocks of the cultivated cinnamon tree, *Cinnamomum zeylanicum* (Nat. Ord. *Laurineæ*). Ceylon.

CHARACTERS.—Closely rolled quills, $\frac{3}{8}$ in. in diameter, and containing several smaller quills, thin, brittle, splintery. Externally dull light yellowish brown, with little scars and faint wavy lines. Internally darker brown. Odour fragrant. Taste warm, sweet, aromatic.

COMPOSITION.—The chief constituents are—(1) The official *volatile oil* (*see* p. 481) 0·2 to 1 per cent. (2) *Tannin.* (3) Sugar and gum.

IMPURITY. Cassia bark.

Cinnamon is contained in Pulvis Catechu Compositus, Pulvis Cretæ Aromaticus, Pulvis Kino Compositus, Decoctum Hæmatoxyli, Tinctura Cardamomi Composita, and Tinctura Lavandulæ Composita.

Dose, 10 to 20 gr.

Preparations.

1. Aqua Cinnamomi.—1 in 20.
Dose, 1 to 2 fl. oz.

2. Pulvis Cinnamomi Compositus.—Cinnamon, 1; cardamoms, 1; ginger, 1.
Dose, 10 to 40 gr.

3. Tinctura Cinnamomi.—Cinnamon, 1; alcohol (70 per cent.), 5. Percolate.
Dose, $\frac{1}{2}$ to 1 fl. dr.

Aqua Cinnamomi is contained in Mistura Cretæ, Mistura Guaiaci, Mistura Olei Ricini, Mistura Spiritus Vini Gallici, Syrupus Aromaticus, and Syrupus Cascaræ Aromaticus.

Compound cinnamon powder is contained in Pilula Aloës et Ferri and Pilula Cambogiæ Composita.

Oleum Cinnamomi.—The oil distilled from cinnamon bark.

CHARACTERS.—Yellowish, becoming cherry-red on keeping. Odour and taste like cinnamon. Sp. gr. 1·025 to 1·035.

COMPOSITION.—The chief constituents are—(1) Cinnamic aldehyde, $C_6H_5C_2H_2COH$, which makes up the greater part (*see* p. 503). (2) A terpene. (3) Eugenol (*see* p. 475).

Dose, ½ to 3 m.

Preparation.

Spiritus Cinnamomi.—Cinnamon, 1; alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885.

Spirit of cinnamon is contained in Acidum Sulphuricum Aromaticum.

ACTION AND THERAPEUTICS.

Oil of cinnamon has the same action as other aromatic volatile oils, and is therefore stomachic and carminative. Cinnamon bark in addition has, in virtue of its tannic acid, some astringent action, and is consequently a common flavouring stomachic vehicle for astringent powders and mixtures, except such as contain iron. Finely powdered cinnamon (60 to 90 gr.) is given morning and evening in acute dysentery.

HORSERADISH.

Armoraciæ Radix.—Horseradish Root. The fresh root of *Cochlearia armoracia* (Nat. Ord. *Cruciferæ*). Collected from cultivated plants.

CHARACTERS.—A long, cylindrical, fleshy root, enlarged at the upper end, where it is marked by scars of fallen leaves.

½ to 1 in. in diameter, and usually a foot or more long. Pale yellowish or brownish white externally; whitish and fleshy within. Taste very pungent. Inodorous unless bruised or scraped, when it gives a pungent odour. *Resembling horse-radish root.*—Aconite root, which is shorter, conical, not cylindrical, darker, and causes tingling and numbness when chewed.

Composition.—The chief constituent is a substance which, by the action of a ferment, yields a volatile oil, butyl sulphocyanide, C_4H_9CNS.

Preparation.

Spiritus Armoraciæ Compositus.—Scraped horseradish root, 5 oz.; dried bitter orange peel, 5 oz.; nutmeg, 55 gr.; alcohol (90 per cent.), 1¼ pints; water, 1½ pints.

Dose, 1 to 2 fl. dr.

Action and Uses.

Horseradish is a condiment having the same action as mustard. It has been used as a counter-irritant. The spirit is a pleasant flavouring and carminative agent.

CAPSICUM.

Capsici Fructus.—*Synonyms.*—Guinea pepper, Pod pepper. The dried ripe fruit of *Capsicum minimum* (Nat. Ord. *Solanaceæ*). Zanzibar.

Characters.—½ to ¾ in. long, ¼ in. in diameter, shrivelled, fusiform. Consists of a dull red, shining, smooth, brittle, translucent pericarp, enclosing several small, roundish, flat seeds. Odour peculiar, pungent. Taste very bitter.

Composition.—The chief constituents are—(1) Capsaicin, a crystallizable acid substance. (2) Capsicine, a volatile alkaloid smelling like coniine. (3) A volatile oil. (4) A resin. (5) Fatty matter.

Dried and powdered it constitutes red pepper.

Impurities.—Various red substances, *e.g.* red-lead.

Dose, ½ to 1 gr.

Preparations.

1. **Tinctura Capsici.**—Capsicum, 1; alcohol (70 per cent.), 20. Macerate.

Dose, 5 to 15 m.

2. Unguentum Capsici. — Capsicum, 12; Spermaceti, 6; Olive oil, 44.

The Tincture is contained in Tinctura Chloroformi et Morphinæ Composita.

ACTION.

The action of capsicum is like that of volatile oils generally. Thus externally it is a powerful rubefacient, irritant, and counter-irritant. Internally in small doses it stimulates the gastric secretions, causes dilatation of the gastric vessels, and excites the muscular coat. It is therefore stomachic and carminative.

THERAPEUTICS.

It is used as a condiment. Medicinally it is given as a stomachic and carminative in dyspepsia when it is required either to excite the appetite and digestion, or to cause the evacuation of gas, and it is applied externally for the usual purpose of an irritant.

GINGER.

Zingiber.—The scraped and dried rhizome of *Zingiber officinale* (Nat. Ord. *Scitamineæ*). East and West Indies.

CHARACTERS.—Flattish, irregularly branched pieces, usually 3 to 4 in. long, each branch marked at its summit by a depressed scar. Externally pale buff, striated, fibrous. Fracture mealy, short, rather fibrous. Odour agreeable, aromatic. Taste strong, pungent. *Resembling ginger.*—Turmeric, which is yellow.

COMPOSITION.—The chief constituents are—(1) An aromatic volatile oil, giving the flavour. (2) Gingerol. (3) Several resins and allied bodies.

Dose, 10 to 20 gr.

Preparations.

1. Syrupus Zingiberis.—Powdered ginger, 1 alcohol (90 per cent.), 2; syrup, 38.

Dose, ½ to 1 fl. dr.

2. Tinctura Zingiberis.—Ginger, 1; alcohol (90 per cent.), 10. Percolate.
Dose, 30 to 60 m.

Ginger is contained in infusion of senna, compound squill pill, the compound powders of cinnamon, jalap, opium, rhubarb, and scammony.

Tincture of Ginger is contained in Acidum Sulphuricum Aromaticum and Liquor Sennæ Concentratus.

ACTION AND THERAPEUTICS.

Its action is the same as that of other substances containing aromatic volatile oils. It is chiefly used as a stomachic, carminative, and flavouring agent.

CARDAMOMS.

Cardamomi Semina.—Cardamom Seeds. The dried ripe seeds of *Elettaria cardamomum* (Nat. Ord. *Scitamineæ*). Malabar. The seeds are best kept in the pericarps, but when required for use they should be separated.

CHARACTERS.—The pericarp is a three-sided capsule, $\frac{3}{4}$ to 1 in. long, $\frac{1}{5}$ to $\frac{2}{5}$ in. broad, of a tough papery character, ovoid, obtusely triangular, shortly beaked, rounded at the base, brownish yellow, longitudinally striated; no odour or taste. Seeds $\frac{1}{6}$ in. long, irregularly angular, transversely wrinkled, reddish brown externally, whitish within. Odour aromatic. Taste warm, aromatic.

COMPOSITION.—The chief constituents are—(1) A volatile oil, which contains a terpene called terpinene, $C_{10}H_{16}$. (2) A fixed oil. The pericarp is medically inactive.

Preparation.

Tinctura Cardamomi Composita.—Cardamoms, $\frac{1}{4}$ oz.; caraway, $\frac{1}{4}$ oz.; raisins, 2 oz.; cinnamon, $\frac{1}{2}$ oz.; cochineal, 55 gr.; alcohol (60 per cent.), 1 pt. Macerate.
Dose, $\frac{1}{2}$ to 1 fl. dr.

Compound tincture of cardamoms is contained in Decoctum Aloës Compositum, and Mistura Sennæ Composita.

Cardamoms are contained in Extractum Colocynthidis Compositum, Pulvis Cinnamomi Compositus, Pulvis Cretæ Aromaticus, Tinctura Gentianæ Composita, and Tinctura Rhei Composita.

ACTION AND THERAPEUTICS.

Cardamoms, because of its volatile oil, acts like cloves or pepper ; therefore it is carminative and stomachic. As it has a pleasant taste, and the tincture is of a red colour, it is much used as a colouring and flavouring agent. The compound tincture is a good flavouring carminative and the Tinctura Carminativa of the Brit. Pharm. Conference is another. It contains cardamoms, 600 gr.; strong tincture of ginger, 1¼ fl. oz. ; oil of cinnamon, oil of caraway, oil of cloves, each 100 ♏ ; rectified spirit to 1 pint. Dose, 2 to 10 ♏.

SUMBUL ROOT.

Sumbul Radix.—*Synonym.*—Musk root. The dried transverse slices of the root of *Ferula sumbul* (Nat. Ord. *Umbelliferæ*). Russia and India.

CHARACTERS.—Usually 1 to 3 in. in diameter, ¾ to 1 in. thick. Outer surface covered with dusky brown, papery, transversely wrinkled bark, with short bristly fibres. Internally spongy, coarsely fibrous, dry, farinaceous, dirty yellowish brown, mottled with whitish patches and spots of exuded resin. Odour musk-like. Taste bitter, aromatic.

COMPOSITION.—The chief constituents are—(1) A volatile oil. (2) Two resins. (3) Valerianic acid. (4) Angelic acid. (5) Sumbulic acid.

Preparation.

Tinctura Sumbul.—Sumbul root, 1; alcohol (70 per cent.), 10. Macerate. This tincture is said to be useless unless the fresh root is used.

Dose, 30 to 60 m.

ACTION AND THERAPEUTICS.

The action of sumbul is the same as that of volatile oils in general. It is only used internally, and is given as a carminative in flatulence. It is also employed in much the same class of cases as valerian—that is to say, in neurotic conditions, hysteria, &c. In Russia it is given chiefly as a reflex stimulant in typhoid fever, dysentery, diarrhœa, &c., for the same purposes as those for which musk is employed in many other countries.

OIL OF LAVENDER.

Oleum Lavandulæ.—The oil distilled from the flowers of *Lavandula vera* (Nat. Ord. *Labiatæ*).

CHARACTERS.—A colourless or pale yellow volatile oil. Odour of lavender. Taste warm, bitter. Sp. gr. 0·85 to 0·89.

IMPURITY.—Oil of spike.

COMPOSITION.—The chief constituents are—(1) Linalool acetate (also found in oil of bergamot). (2) Linalool, $C_{10}H_{17}OH$, which is an alcohol and an oxidation product of the terpene myrcene $C_{10}H_{16}$.

Dose, ½ to 3 m.

Preparations.

1. Spiritus Lavandulæ.—Oil of Lavender, 1; alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885.

2. Tinctura Lavandulæ Composita.—Oil of lavender, 45 ♏; oil of rosemary, 5 ♏; cinnamon, 75 gr.; nutmeg, 75 gr.; red sanders-wood, 150 gr.; alcohol (90 per cent.), 20 fl. oz. Maccrate.

Dose, ½ to 1 fl. dr.

Oil of lavender is contained in Linimentum Camphoræ Ammoniatum.

Compound tincture of lavender is contained in Liquor Arsenicalis.

ACTION AND THERAPEUTICS.

Oil of lavender has the same action as other aromatic volatile oils. It is used externally as a pleasant stimulating component of liniments, and most red lotions (*see* p. 164) are coloured with the compound tincture. Internally, especially in the form of the tincture, it makes a very agreeable gastric stimulant, carminative, and colouring agent.

OIL OF PEPPERMINT.

Oleum Menthæ Piperitæ.—The oil distilled from the fresh flowering peppermint, *Mentha piperita* (Nat. Ord. *Labiatæ*).

Characters.—Colourless, pale, or greenish yellow, thickening and becoming reddish with age. Odour like that of peppermint. Taste aromatic, followed by a sense of coldness. Sp. gr. 0·9 to 0·92.

Composition.—The chief constituents are—(1) *Menthol*, or mint camphor, $C_{10}H_{19}\cdot OH$ (*see* p. 566). (2) Menthene, $C_{10}H_{18}$, a liquid terpene.

Dose, $\frac{1}{2}$ to 3 m.

Preparations.

1. Aqua Menthæ Piperitæ.—1 in 1500.
Dose, 1 to 2 fl. oz.

2. Spiritus Menthæ Piperitæ.—Oil of peppermint, 1; alcohol (90 per cent.), 9.
Dose, 5 to 20 m.

This is five times as strong as in B. P. 1885, and contains half the oil in the essence of peppermint in B. P. 1885.

Oil of peppermint is contained in Pilula Rhei Composita and Tinctura Chloroformi et Morphinæ Composita.

Action and Therapeutics.

The action of oil of peppermint is the same as that of volatile oils generally, but the cool numb feeling often produced by volatile oils after the sensation of warmth has passed off is especially well marked with oil of peppermint, and this effect, which is due to the menthol in it, has caused it to be applied externally in neuralgia. Like many other volatile oils it is a powerful antiseptic.

Internally it is a powerful stomachic and carminative, is often used as such, and also as a flavouring agent.

OIL OF SPEARMINT.

Oleum Menthæ Viridis.—The volatile oil distilled from the fresh flowering spearmint *Mentha viridis* (Nat. Ord. *Labiatæ*).

Characters.—Very like oil of peppermint.

Composition.—The chief constituents are—(1) *Menthene*, the same terpene as in peppermint. (2) *Carvone*, $C_{10}H_{14}O$; also found in oil of caraway (*see* p. 491).

Dose, $\frac{1}{2}$ to 3 m.

Preparation.

Aqua Menthæ Viridis.—1 in 1500.
Dose, 1 to 2 fl. oz.

ACTION AND THERAPEUTICS.

These are the same as those of oil of peppermint.

ANISE.

Anisi Fructus.—Anise Fruit. The dried ripe fruit of *Pimpinella anisum* (Nat. Ord. *Umbelliferæ*).

CHARACTERS.—Anise fruits are about ⅕ in. in length, oval-oblong, greyish-brown in colour, and the whole surface is covered with short hairs. The two mericarps are united and attached to a common stalk; each is traversed by five pale slender ridges, and its transverse section exhibits about fifteen vittæ. Odour agreeable, aromatic. Taste sweetish, spicy.

COMPOSITION.—The chief constituent is the official *volatile oil* (q.v.)

Preparation.

Aqua Anisi.—Anise fruit bruised, 1; water, 20.
Dose, 1 to 2 fl. oz. or more.

Oleum Anisi.—The volatile oil, distilled from the anise fruit (*see* above), or from the star-anise fruit (*Illicium verum*), Nat. Ord. *Magnoliaceæ*.

CHARACTERS.—Colourless or very pale yellow, with the odour of the fruit, and an aromatic, sweetish taste. Sp. gr. 0·975 to 0·99.

COMPOSITION.—The chief constituents are—(1) A terpene, 20 per cent. (2) Anethol, 80 per cent., $C_{10}H_{12}O$.

Dose, ½ to 3 m.

Preparation.

Spiritus Anisi.—Oil of anise, 1; alcohol (90 per cent.), 9.

Dose, 5 to 20 m.

This contains half the amount of oil of anise in the Essence of Anise, B. P. 1885.

Oil of anise is contained in Tinctura Camphoræ Composita and Tinctura Opii Ammoniata.

ACTION AND THERAPEUTICS.

The action of oil of anise is the same as that of aromatic oils generally. It is specially used to get rid of flatulence in children, and, on account of its slightly expectorant action, as a basis of cough mixtures.

CORIANDER FRUIT.

Coriandri Fructus.—The dried ripe fruit of *Coriandrum sativum* (Nat. Ord. *Umbelliferæ*). Britain.

CHARACTERS.—Nearly globular, $\frac{1}{5}$ in. in diameter, and consisting of two closely united hemispherical mericarps, crowned by the calyx teeth and stylopod, brownish yellow, hard, faintly ribbed with both primary and secondary ridges. The mericarps each enclose a lenticular cavity, and each is furnished on its commissural surface with two brown vittæ. Taste agreeable, mild, aromatic. Odour pleasant when bruised.

COMPOSITION.—The chief constituent is the official *volatile oil* (q.v.).

Coriander fruit is contained in Confectio Sennæ, Syrupus Rhei, Tinctura Rhei Composita, Tinctura Sennæ Composita.

Oleum Coriandri.—A volatile oil distilled from the fruit.

CHARACTERS.—Colourless or pale yellow, with the odour and taste of the fruit. It is isomeric with Borneo camphor (*see* p. 563). Sp. gr. 0·87 to 0·88.

Dose, $\frac{1}{2}$ to 3 m.

Oil of coriander is contained in Syrupus Sennæ.

ACTION AND THERAPEUTICS.

Oil of coriander has the same action as other volatile oils. It is chiefly used as a stomachic and carminative, and to disguise the taste of rhubarb and senna.

FENNEL FRUIT.

Fœniculi Fructus.—The dried fruit of cultivated plants of *Fœniculum capillaceum* (Nat. Ord. *Umbelliferæ*). Malta.

CHARACTERS.—$\frac{1}{5}$ to $\frac{2}{5}$ in. long, ovoid-oblong, curved, smooth, greenish brown or brown, capped by a conspicuous stylopod and two styles. Odour aromatic. Taste aromatic, sweet. Fruit readily separated into its two mericarps, each of which has five prominent primary ridges, and exhibits in transverse section six large vittæ. *Resembling fennel.*—Conium fruit (fennel is larger and has prominent vittæ), caraway, and anise fruits.

COMPOSITION.—The chief constituent is a volatile oil probably identical with oil of anise.

Preparation.

Aqua Fœniculi.—Fennel fruit, 1; water, 20.
Dose, 1 to 2 fl. oz.

Fennel fruit is contained in Pulvis Glycyrrhizæ Compositus.

ACTION AND THERAPEUTICS.

The same as those of oil of anise or of coriander fruit.

CARAWAY FRUIT.

Carui Fructus.—Caraway Fruit. The dried fruit of *Carum carvi* (Nat. Ord. *Umbelliferæ*). England and Germany.

CHARACTERS.—The fruit is usually separated into its two mericarps, each about $\frac{1}{4}$ to $\frac{1}{6}$ in. long, slightly curved, tapering at each end, brown, with five pale longitudinal ridges; the transverse section of each mericarp exhibits six vittæ. Odour agreeable, aromatic. Taste pleasant, sweetish, spicy. *Resembling caraway.*—Conium and fennel. Known by the small ridges and the spicy taste of caraway.

COMPOSITION.—The chief constituent is the volatile oil (q.v.).

Preparation.

Aqua Carui.—Caraway, 1; water, 20.
Dose, 1 to 2 fl. oz.

Caraway fruit is contained in Pulvis Opii Compositus, Confectio Piperis, Tinctura Cardamomi Composita, Tinctura Sennæ Composita.

Oleum Carui.—The oil distilled from caraway fruit.

CHARACTERS.—Pale yellow, with odour and taste like the fruit. Sp. gr. 0·91 to 0·92.

COMPOSITION.—The chief constituents are—(1) Cymene, $CH_3C_6H_4{\cdot}CH(CH_3)_2$; also found in eucalyptus oil. (2) Cuminal, cymene aldehyde; this is the essential constituent. (3) Dextro-rotatory carvone, $C_{10}H_{14}O$, isomeric with thymol (*see* p. 565); also found in oil of spearmint (p. 487). (4) Limone, a terpene, $C_{10}H_{16}$.

Dose, ½ to 3 m.

Oil of caraway is contained in Pilula Aloës Barbadensis.

ACTION AND THERAPEUTICS.

The action and uses of oleum carui are the same as those of other aromatic volatile oils. It is employed as a carminative, stomachic, and flavouring agent.

DILL FRUIT.

Anethi Fructus.—The dried ripe fruit of *Peucedanum graveolens* (Nat. Ord. *Umbelliferæ*). Middle and Southern Europe.

CHARACTERS.—Broadly oval, ⅙ in. long, brown, flat, with a pale, broad, membranous border. Mericarps distinct, each shows six vittæ. Odour and taste agreeable and aromatic. *Resembling dill.*—Conium, anise, fennel, caraway; but dill is winged.

COMPOSITION.—The chief constituent is the official *volatile oil* (q.v.).

Preparation.

Aqua Anethi.—Dill fruit, 1; water, 20.
Dose, 1 to 2 fl. oz.

Oleum Anethi.—The oil distilled from the dill fruit.

CHARACTERS.—Pale yellow. Odour pungent. Taste hot and sweetish. Sp. gr. 0·905 to 0·920.

COMPOSITION.—The chief constituents are almost identical with those of caraway oil (*see* above).

Dose, ½ to 3 m.

ACTION AND THERAPEUTICS.

The same as those of anise and caraway. Dill water is a common carminative for children, and it covers very well the taste of sodium salts.

ELDER FLOWERS.

Sambuci Flores.—Elder Flowers. The fresh flowers of *Sambucus nigra* separated from the stalks (Nat. Ord. *Caprifoliaceæ*). Britain.

CHARACTERS.—In corymbose cymes, 5 to 7 in. across. Flowers small; calyx superior, five-toothed; corolla flat, rotate, five-sected, creamy white, with five stamens inserted in the tube. Odour fragrant, somewhat sickly. Taste bitter.

COMPOSITION.—The chief constituents are—(1) A resin. (2) Valerianic acid. (3) A minute amount of a volatile oil.

Preparation.

Aqua Sambuci.—Elder flowers, 1; water, 5.
Dose, 1 to 2 fl. oz.

ACTION AND THERAPEUTICS.

Elder flowers are used to flavour medicines.

CHAMOMILE.

Anthemidis Flores.—Chamomile Flowers. The dried expanded flower heads of *Anthemis nobilis* (Nat. Ord. *Compositæ*). Collected from cultivated plants.

CHARACTERS.—About ½ to ¾ in. in diameter, hemispherical, white or nearly white. Involucre composed of several rows of oblong bracts with membranous margins. Receptacle solid, covered with bracts. Florets ligulate and white. Odour aromatic. Taste bitter.

COMPOSITION.—The chief constituent is the official *volatile oil.*

Oleum Anthemidis.—The official volatile oil distilled from chamomile flowers.

CHARACTERS.—Pale blue or greenish blue, becoming yellowish brown. Odour and taste like chamomile. Sp. gr. 0·905 to 0·915.

COMPOSITION.—The chief constituents are—(1) A terpene, $C_{10}H_{16}$. (2) Angelates and tiglates of amyl and butyl. (3) A bitter principle.

Dose, ½ to 3 m.

Preparation.

Extractum Anthemidis.—Chamomile flowers, 1 lb.; oil of chamomile, 15 ♏; water, 1 gallon.
Dose, 2 to 8 gr.

ACTION AND THERAPEUTICS.

A poultice made with chamomile flowers is a popular domestic remedy. All its virtues are due to its warmth. Internally, like other volatile oils, oil of chamomile is a stomachic and carminative. An infusion is in large doses a simple emetic.

ROSE PETALS.

Rosæ Gallicæ Petala.—Red Rose Petals. The fresh and dried unexpanded petals of *Rosa gallica* (Nat. Ord. *Rosaceæ*). From cultivated plants. Britain.

Characters.—Little cone-shaped masses or separate petals; purplish red, velvety. Odour fragrant, roseate. Taste bitterish, feebly acid, and astringent.

Composition.—The chief constituents are—(1) *Oleum Rosæ*, a volatile oil present in minute quantities (*see* below). (2) Tannic and gallic acids.

Preparations.

1. **Confectio Rosæ Gallicæ.**—*Fresh* petals, 1; sugar, 3.
Dose, 30 to 60 gr.

2. **Infusum Rosæ Acidum.**—*Dried* petals, 1 dilute sulphuric acid, ½; boiling water, 40.
Dose, ½ to 1 fl. oz.

3. **Syrupus Rosæ.**—*Dried* petals, 1; sugar, 15; boiling water, 10.
Dose, ½ to 1 fl. dr.

OIL OF ROSE.

Oleum Rosæ.—*Synonym.*—Otto of Rose. The oil distilled from the fresh flowers of *Rosa damascena* (Nat. Ord. *Rosaceæ*).

Characters and Tests.—At low temperatures a pale yellow crystalline semi-solid, melting between 67° and 72° F. to a pale yellow oil with a strong rose odour and taste. Sp. gr. 0·856 to 0·860.

Composition.—The chief ingredient is geraniol or rhodinol, a fragrant liquid. It is an alcohol and is related to linalool, which occurs in oil of lavender (p. 486).

Preparations.

1. **Aqua Rosæ.**—Rose water. The rose water of commerce, which is a saturated solution of oleum rosæ, diluted immediately before use with twice its volume of distilled water.
Dose, 1 to 2 fl. oz.

2. Unguentum Aquæ Rosæ.—Rose water, undiluted, 7 fl. oz.; white beeswax, $1\frac{1}{2}$ oz.; spermaceti, $1\frac{1}{2}$ oz.; almond oil, 9 fl. oz.; oil of rose, 8 ♏. *Synonym.*—Cold Cream.

Rose water is contained in Mistura Ferri Composita and certain lozenges.

ACTION AND THERAPEUTICS.

The preparations of rose petals are pleasant vehicles. The infusion is mildly astringent.

CLASS III. OF **Volatile Oils.**

Those used chiefly for their actions on the heart and central nervous system.

VALERIAN.

Valerianæ Rhizoma.—Valerian Rhizome. The erect dried rhizome and roots of *Valeriana officinalis* (Nat. Ord. *Valerianeæ*). Collected in the autumn.

CHARACTERS.—Short, erect rhizome, entire or sliced. Externally dark yellowish brown, giving off many slender, brittle, shrivelled rootlets, 3 to 4 in. long. Internally whitish. Odour developed in drying, strong, peculiar, disagreeable. Taste unpleasant, camphoraceous, bitter. *Resembling valerian.*—Serpentary, arnica, green hellebore; but valerian is known by its odour.

COMPOSITION.—The chief constituents are—(1) *A volatile oil* containing valerianic, formic, and acetic acids united with pinene, a terpene (*see* p. 457), and borneol (*see* p. 563). If the oil is kept it decomposes slightly and *valerianic acid*, $HC_5H_9O_2$, is set free. This exists in many plants, and in cod-liver oil. The amount of it in valerian increases by keeping. It can be derived from amylic alcohol, $C_5H_{11}OH$ (valeryl aldehyde). It is colourless, oily, with the odour of valerian, and strongly acid, with a burning taste. *Solubility.*—1 in 30 of water; easily in alcohol and ether.

Preparation.

Tinctura Valerianæ Ammoniata.—Powdered valerian, 4 oz.; oil of nutmeg, 30 ♏; oil of lemon, 20 ♏; solution of ammonia, 2 fl. oz.; alcohol (60 per cent.), 18 fl. oz. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Zinci Valerianas.—Zinc Valerianate or Zinc Isovalerianate. $Zn(C_5H_9O_2)_2$.

SOURCE.—Mix hot solutions of zinc sulphate and sodium isovalerianate, evaporate and zinc valerianate crystallizes out, or it may be made by saturating isovalerianic acid with zinc carbonate.

CHARACTERS.—Pearly scales with a feeble odour of sodium valerianate and a metallic taste. *Solubility.*—1 in 120 of water.

INCOMPATIBLES.—All acids, soluble carbonates, most metallic salts, vegetable astringents.

Dose, 1 to 3 gr.

ACTION.

Neither valerianic acid nor zinc valerianate is known to have any action.

Valerian itself acts in virtue of its volatile oil, which has the same properties as other volatile oils. Valerian is therefore an irritant when applied externally; internally it stimulates the mouth, stomach, and intestines; consequently it increases the appetite and the vascularity, the secretion, and the peristaltic action of the stomach and intestines; and in its excretion, which takes place chiefly through the bronchial mucous membrane, kidneys, and genito-urinary mucous membrane, it excites the flow of fluids excreted through these parts. Acting reflexly from the stomach, it stimulates the circulation rather more powerfully than most volatile oils.

THERAPEUTICS.

Preparations of valerian, or still better the oil (2 to 5 ♏) suspended in mucilage with cinnamon water, are often given as carminatives in cases of flatulence, and as reflex stimulants in fainting, palpitation, &c. Valerian and valerianates sometimes relieve neuralgia, and they are often prescribed for hysteria and other neurotic conditions, but frequently without benefit.

ASAFETIDA.

Asafetida.—A gum-resin obtained by incision into the root of *Ferula fetida*, and probably other species (Nat. Ord. *Umbelliferæ*). Afghanistan and the Punjaub.

CHARACTERS.—Usually in irregular masses, composed of dull yellow tears agglutinated together by darker coloured, softer material. When broken or cut, the exposed surface has an amygdaloid appearance; the fractured surface is opaque, milk-white at first, but becomes first purplish pink and finally dull yellowish brown. Odour strong, alliaceous, persistent. Taste bitter, acrid, alliaceous. Asafetida forms a white emulsion with water. The fractured surface of a tear, on being touched with nitric acid, becomes a fine green. *Resembling asafetida.*—Galbanum, ammoniacum, and benzoin, distinguished by their peculiar odours, which differ markedly from that of asafetida.

COMPOSITION.—The chief constituents are—(1) *A volatile oil*, 5 per cent., containing essential oil of garlic, persulphide of allyl, $(C_3H_5)_2S$. This gives asafetida its very unpleasant odour. (2) Bassorin resin, 65 per cent. (3) Gum, 25 per cent.

IMPURITIES.—Earthy matter.

Dose, 5 to 15 gr.

Preparations.

1. Pilula Aloës et Asafetidæ.—Asafetida, Socotrine aloes, hard soap, and confection of roses, equal parts.

Dose, 4 to 8 gr.

2. Spiritus Ammoniæ Fetidus.—Asafetida, $1\frac{1}{2}$; strong solution of ammonia, 2; alcohol (90 per cent.), 18.

Dose, 20 to 40 m. for repeated, **60 to 90** for single administration.

3. Tinctura Asafetidæ.—Asafetida, 4; alcohol (70 per cent.), 20. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr. The resin precipitates on the addition of water, but may be re-dissolved in ammonia or suspended in mucilage.

Asafetida is contained in Pilula Galbani Composita.

ACTION.

Both internally and externally, asafetida, in virtue of its volatile oil, acts like volatile oils generally. Its action as a stimulant to the intestinal muscle is especially well marked, hence it is combined with aloes in Pilula Aloës et Asafetidæ; and the enema of it will relieve flatus. Owing to its containing oil of garlic it is extremely nasty, and therefore it is not, like many volatile oils, available as a condiment. Its taste is credited with some mental effect in cases of hysteria.

THERAPEUTICS.

Asafetida is not used externally. Internally it is prescribed to aid the action of other purgatives, and also to stimulate the muscular coat to expel flatus. It may be given by the mouth or as the enema. Partly on account of its reflex stimulating effect, but also on account of its very nasty taste, it is used to control hysterical, emotional, and other mental disturbances, but it often fails. For this purpose it may be combined with valerian. Cases of malingering may sometimes be cured by making the patient take, three times a day, an effervescing draught containing a few minims of each of the tinctures of valerian and asafetida. The effervescence makes the nasty taste of these medicines "repeat" in the mouth for some time after taking them. Asafetida oil would in the course of its excretion disinfect the urine and the expectoration, but its smell forbids its use for these purposes.

GALBANUM.

Galbanum.—A gum resin obtained from *Ferula galbaniflua* (Nat. Ord. *Umbelliferæ*), and probably other species. Persia and the Levant.

CHARACTERS.—Tears or masses of agglutinated tears. Tears roundish, about the size of a pea, yellowish brown or yellowish orange. Translucent, rough and dirty. Hard and brittle in the cold, softening with heat and becoming sticky. Masses contain pieces of root, stem, &c. They are hard, compact, yellowish brown or green. Odour peculiar, aromatic. Taste bitter, unpleasant. *Resembling galbanum.*—Ammoniacum, asafetida, benzoin; known by their different odours.

COMPOSITION.—The chief constituents are—(1) Volatile oil, 6 to 9 per cent., consisting chiefly of a terpene, $C_{10}H_{16}$. (2) A sulphurous resin, 60 to 67 per cent. (3) Gum, 19 to 22 per cent. (4) Umbelliferone.

Dose, 5 to 15 gr.

Preparation.

Pilula Galbani Composita.—*Synonym.*—Compound Pill of Asafetida. Galbanum, 2; asafetida, 2; myrrh, 2; syrup of glucose, 1.

Dose, 4 to 8 gr.

This pill is almost the same as Pilula Asafetidæ Composita, B. P. 1885.

ACTION AND THERAPEUTICS.

Galbanum acts like other substances containing volatile oils; it is always combined with ammoniacum or asafetida. It has been used externally as a plaster for its irritant effect, to aid the absorption of old inflammatory products, and internally it is given with asafetida as a carminative.

AMMONIACUM.

Ammoniacum.—A gum-resin exuding from the flowering and fruiting stem of *Dorema ammoniacum* and probably other species (Nat. Ord. *Umbelliferæ*). Persia and the Punjaub.

CHARACTERS.—Small roundish tears, or masses of agglutinated tears; pale brown externally, darkening on keeping, milky white and opaque internally. Hard and brittle when cold, with a dull waxy fracture, but softening with heat. Odour faint, peculiar, non-alliaceous. Taste bitter, acrid. Forms a nearly white emulsion with water. *Resembling ammoniacum.*—Asafetida, galbanum, benzoin, known by odour.

COMPOSITION.—The chief ingredients are—(1) Volatile oil, 4 per cent. (2) Resin, 70 per cent. (3) Gum, 20 per cent.

Dose, 5 to 15 gr.

Preparations.

1. **Emplastrum Ammoniaci cum Hydrargyro.**—Ammoniacum, 656; mercury, 164; olive oil, 7; sublimed sulphur, 1.

2. **Mistura Ammoniaci.**—Ammoniacum 1, added gradually during trituration to 30 of water and 2 of syrup of tolu. It forms a milk-like emulsion.

Dose, $\frac{1}{2}$ to 1 fl. oz.

Ammoniacum is contained in Pilula Ipecacuanhæ cum Scillâ, and Pilula Scillæ Composita.

ACTION AND THERAPEUTICS.

The actions of ammoniacum are precisely the same as those of volatile oils generally. It is employed externally to aid, by its mildly irritating effects, the absorption of chronic inflammatory products, and internally in chronic bronchitis with offensive expectoration for the sake of the remote disinfectant expectorant effect that it has in the course of its excretion through the bronchial mucous membrane.

MYRRH.

Myrrha.—A gum-resin obtained from the stem of *Balsamodendron myrrha* and probably other species (Nat. Ord. *Burseraceæ*). Collected in Arabia and Abyssinia.

CHARACTERS.—Roundish or irregularly formed tears or masses of agglutinated tears, varying very much in size. Externally reddish brown or reddish yellow; dry, covered with a fine powder; brittle. The fractured surface is irregular, brown, somewhat translucent, and oily. Odour agreeable, aromatic. Taste aromatic, acrid, bitter. Insoluble in water; when rubbed up with it, forms an emulsion.

COMPOSITION.—The chief constituents are—(1) *Myrrhin*, a resin, 23 per cent. (2) *Myrrhol*, $C_{10}H_{11}O$, a volatile oil, 2 per cent. (3) Gum, 60 per cent. (4) A bitter principle.

IMPURITIES.—Many varieties of gum and gum-resins.

Dose, 10 to 30 gr.

Preparations.

1. **Tinctura Myrrhæ.**—Myrrh, 1; alcohol (90 per cent.), 5. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

2. **Pilula Aloës et Myrrhæ.**—1 in $4\frac{1}{2}$ (*see* Alo Socotrina, p. 441).

Myrrh is contained in Decoctum Aloës Compositum, Mistura Ferri Composita, Pilula Galbani Composita, and Pilula Rhei Composita.

ACTION.

External.—Both externally and internally myrrh has the same actions as other substances containing a volatile oil. It is a mild disinfectant, and a stimulant to sores and ulcers.

Internal.—It has the same effects in the mouth. It is a **stomachic carminative**, exciting the appetite, the flow of gastric juice, and the vascularity and peristalsis of the stomach and intestines. The number of leucocytes in the blood is said to be increased by the administration of myrrh. It is excreted by mucous membranes, especially the genito-urinary and the bronchial, and it stimulates and disinfects their secretions in its passage through them. Thus it becomes an expectorant, a uterine stimulant, and an emmenagogue.

THERAPEUTICS.

External.—Occasionally myrrh has been employed as a stimulant to sores and ulcers.

Internal.—It is, in the form of $\frac{1}{2}$ fl. dr. of the tincture diffused through 1 fl. oz. of water, used as a mouth wash and gargle for sore spongy gums, relaxed throat, and other similar conditions, for which it is often combined with borax, as in the following formula: —Myrrh, 1; eau de Cologne, 16; borax, 1; water, 3; syrup, 3. It is frequently given with purgatives for the sake of its carminative and stomachic properties. It is also commonly combined with iron when this drug is given for anæmia, but the reason for this is not clear. It is prescribed for amenorrhœa, and has been given for cystitis, and as a disinfectant expectorant for chronic bronchitis.

CLASS IV. OF **Volatile Oils.**

Those used chiefly for their action on the bronchial mucous membrane.

TEREBENE.

Terebenum.—Terebene. A mixture of dipentene and other hydrocarbons.

Source.—Produced by agitating oil of turpentine with successive portions of sulphuric acid until it no longer rotates the plane of a ray of polarized light, and then distilling in a current of steam.

Characters.—Colourless liquid, with a pleasant pine-wood odour. It does not mix with water, but can easily be emulsified with tragacanth, or it may be taken on sugar. Sp. gr. 0·862 to 0·866.

Dose, 5 to 15 m.

Action and Therapeutics.

Terebene is an excellent stimulating disinfectant expectorant for chronic bronchitis. It may be used as an inhalation thus: Terebene, 40 ♏; light carbonate of magnesium, 20 gr.; distilled water, 1 fl. oz. Use a fluid drachm of this mixture in a pint of water at 140° F. in an apparatus so arranged that air can be drawn through it and inhaled. Or it may be given with other expectorants in a mixture; many patients find five drops a few times a day on sugar quite sufficient to cure a slight winter cough.

BALSAM OF PERU.

Balsamum Peruvianum.—A balsam exuded from the trunk of *Myroxylon Pereiræ* (Nat. Ord. *Leguminosæ*), after the bark has been beaten and scorched. From Salvador in Central America.

Characters.—A liquid about as viscid as treacle, nearly black in bulk; in thin layers orange or reddish brown, and transparent. Odour balsamic. Taste disagreeable, burning. *Solubility.*—Insoluble in water, easily in chloroform, and in 1 of alcohol (90 per cent.), but on the addition of more alcohol the mixture becomes turbid.

Composition.—The chief constituents are—(1) A volatile oil. This is present in large quantities; it consists of cinnamin (cinnamate of benzyl), styracin (cinnamate of cinnamyl), $C_8H_7COOC_9H_9$, peruvin (benzyl alcohol), styrone (cinnamic alcohol), and benzoate of benzyl. (2) Cinnamic acid, $C_6H_5 \cdot CH \cdot CH \cdot COOH$ (*see* p. 503). (3) Benzoic acid (*see* p. 570). (4) Resins.

Dose, 5 to 15 m. or more, made into an emulsion with mucilage or yolk of egg.

ACTION AND THERAPEUTICS.

External.—Like most substances containing a volatile oil, balsam of Peru is a disinfectant, and also a stimulant when rubbed into the skin or applied to raw surfaces. Formerly it was much used for these purposes, chiefly as an application to indolent sores and chronic eczema. A mixture of balsam of Peru 1 part, lard 7 parts, is very useful for sore nipples and cracked lips. Now it is not often employed externally except as an antiparasitic for pediculi, scabies, and ringworm. An ointment consisting of balsam of Peru 20, olive oil 50, petroleum 100 parts, may be used. For scabies it should be applied in the way already described for sulphur ointment; it is a more agreeable preparation.

Internal.—Like most volatile oils it is carminative and stomachic, and after absorption is excreted by, and stimulates and disinfects the mucous membranes. For this reason it is used as an **expectorant** in chronic bronchitis. It is also excreted by the skin and the kidneys.

BALSAM OF TOLU.

Balsamum Tolutanum.—A balsam which on incision exudes from the trunk of *Myroxylon toluifera* (Nat. Ord. *Leguminosæ*). New Granada.

CHARACTERS.—A reddish-yellow, soft, tenacious solid, becoming hard by keeping and brittle in the cold. A lens shows microscopic crystals of cinnamic acid. Very fragrant odour. Taste aromatic. *Solubility.*—Easily in alcohol (90 per cent.), not in water.

COMPOSITION.—The chief constituents are—(1) Toluene, $C_{10}H_{16}$. (2) Benzoic acid (*see* p. 570). (3) Cinnamic acid, $C_6H_5 \cdot CH \cdot CH \cdot COOH$ (*see* p. 503). (4) Resins.

Dose, 5 to 15 gr. as an emulsion with mucilage or yolk of egg.

Preparations.

1. Syrupus Tolutanus.—Balsam of Tolu, $1\frac{1}{4}$ oz.; sugar, 2 lbs.; water to make 3 lbs. (contains very little balsam of tolu, as that is almost insoluble in syrup).

Dose, $\frac{1}{2}$ to 1 fl. dr.

2. Tinctura Tolutana.—Balsam of Tolu, 1; alcohol (90 per cent.), 10. Macerate.

Dose, 30 to 60 m. The balsam of tolu is precipitated by adding water, therefore it should be suspended with mucilage.

Balsam of Tolu is contained in Tinctura Benzoini Composita.

Tincture of Tolu is contained in Trochisci Acidi Carbolici, Morphinæ, and Morphinæ et Ipecacuanhæ.

Syrup of Tolu is contained in Mistura Ammoniaci.

ACTION AND THERAPEUTICS.

Although it has an action in all respects similar to that of balsam of Peru, it is only used as an **expectorant** in cough mixtures.

STORAX.

Styrax Præparatus.—Prepared Storax. A purified balsam obtained from the trunk of *Liquidambar orientalis* (Nat. Ord. *Hamamelaceæ*). Asia Minor.

CHARACTERS.—A brownish-yellow, semi-transparent, semi-fluid balsam. Odour strong, agreeable. Taste balsamic.

COMPOSITION.—The chief constituents are—(1) Styrene, $C_6H_5 \cdot CH \cdot CH_2$, a derivative of cinnamic acid. (2) Cinnamic acid $C_6H_5 \cdot CH \cdot CH \cdot COOH$, colourless, odourless, crystalline, can be oxidized to benzoic acid, is also found in cinnamon, and balsams of Tolu and Peru. (3) Styracin, which is cinnamate of cinnamyl $C_8H_7COOC_9H_9$. (4) Two resins.

Dose, 5 to 20 gr.

Storax is contained in Tinctura Benzoini Composita.

ACTION AND THERAPEUTICS.

Storax has just the same action as balsams of Tolu and Peru and benzoin, and may be employed for the same purposes. It is not often given internally except in the compound tincture of benzoin. Mixed with an equal part of olive oil it may be used to kill the *Sarcoptes hominis* and pediculi.

OIL OF PINE.

Oleum Pini.—The oil distilled from the fresh leaves of *Pinus pumilio* (Nat. Ord. *Coniferæ*). Russia.

Characters.—Almost colourless. Odour aromatic. Taste pungent. Sp. gr. 0·865 to 0·87.

Composition.—The same as that of oil of turpentine.

Action and Therapeutics.

The action of oil of pine is the same as that of oil of turpentine (*see* p. 457). It is pleasanter to inhale, and forms a useful stimulating disinfectant expectorant inhalation in chronic bronchitis or laryngitis. To make an inhalation of it take of oil of pine, 40 ♏; rub with 20 gr. of light carbonate of magnesium, which helps to suspend it; add water, 1 fl. oz. Put 1 fl. dr. of this in a mixture of half a pint of cold and half a pint of boiling water in a vessel so arranged that air drawn through the fluid can be inhaled.

Grindelia.—(Not official.)

The leaves and flowering tops of *Grindelia robusta* and *Grindelia squarrosa* (Nat. Ord. *Compositæ*). California.

Composition.—The chief constituents are—(1) A volatile oil. (2) A resin allied to saponin. (3) Probably an alkaloid.

Preparation (Brit. Pharm. Conference).

Extractum Grindeliæ Liquidum.—Alcoholic. **Dose, 10 to 30 m.**

Action and Therapeutics.

In small doses grindelia is a mild stomachic and cardiac sedative, but its main action depends upon the fact that in its excretion by the bronchial mucous membranes it acts as an expectorant, and also relaxes the muscular coat of the bronchial tubes, and this probably explains its efficacy in asthma. Two or three doses of twenty or thirty minims of the liquid extract (in milk, to prevent the resin, which is precipitated by water, adhering to the vessel) given every twenty minutes will often allay the paroxysms of asthma. Between the attacks this dose should be taken thrice a day. The same quantity may with advantage be added to mixtures prescribed for chronic bronchitis, for not only is grindelia an expectorant, but it relieves the asthma-like paroxysms which so often accompany bronchitis. It is very bitter; its taste is best concealed by Spiritus Chloroformi.

In America cloths soaked in a lotion of 1 fl. dr. of the fluid extract to 6 fl. oz. of water are applied to the skin for the dermatitis caused by *Rhus toxicodendron*, the poison ivy. The same lotion is used in burns, and as an injection in gleet and leucorrhœa.

CLASS V. OF **Volatile Oils.**

Those used chiefly for their action on the kidneys and genito-urinary tract.

OIL OF JUNIPER.

Oleum Juniperi.—The oil distilled from the full-grown unripe green fruit of *Juniperus communis* (Nat. Ord. *Coniferæ*). North Europe.

CHARACTERS.—Colourless or pale yellow. Odour characteristic. Taste warm, aromatic. Sp. gr. 0·865 to 0·890.

COMPOSITION.—Oil of juniper is composed chiefly of a terpene isomeric with oil of turpentine, $C_{10}H_{16}$.

Dose, ½ to 3 m.

Preparation.

Spiritus Juniperi.—Oil of juniper, 1; alcohol (90 per cent.), 19.

Dose, 20 to 60 m.

This is two and a half times as strong as in B. P. 1885.

Spirit of juniper is contained in Mistura Creasoti.

ACTION.

Oil of juniper has much the same action as oil of turpentine; but it is not so liable to upset the digestion; and although it is a powerful renal stimulant and diuretic, it does not easily cause hæmaturia and albuminuria.

THERAPEUTICS.

It is not used externally. Occasionally it is given as a pleasant carminative and stomachic, but its main use is as a diuretic in heart disease, hepatic ascites, and chronic Bright's disease. It must not be given in the acute form, and should always be combined with other diuretics. It certainly markedly increases the quantity of the urine, which it causes to smell like violets. As it is a constituent of Hollands and gin, these are good forms of alcohol for persons suffering from the above diseases.

BUCHU.

Buchu Folia.—*Synonym.*—Bucco. The dried leaves of *Barosma betulina* (Nat. Ord. *Rutaceæ*). Cape of Good Hope.

CHARACTERS.—From ½ to ¾ in. long. Rhomboid ovate, glabrous, dull yellowish green, marked on the margins, especially the under surface, with oil-glands; peculiar strong odour; aromatic, mint-like taste. *Resembling buchu.*—Senna and Uva Ursi, which have entire leaves.

IMPURITY.—Leaves of *Emplanum serrulatum*, which have no glands.

COMPOSITION.—The chief constituents are—(1) A yellowish-brown volatile oil from the glands; it consists of barosma camphor in solution in a liquid hydrocarbon. The camphor is deposited on exposure to air. (2) A bitter principle. (3) Mucilage.

Preparations.

1. **Infusum Buchu.**—1 in 20 of boiling water.
Dose, 1 to 2 fl. oz.

2. **Tinctura Buchu.**—Buchu, 1; alcohol (60 per cent.), 5. Percolate.
Dose, ½ to 1 fl. dr.

ACTION AND THERAPEUTICS.

A medicinal dose of buchu causes a slight feeling of warmth in the stomach, and a large one gives rise to vomiting. The volatile oil diffuses into the blood and is excreted by the bronchial mucous membrane, which it stimulates, and buchu is therefore occasionally given as an expectorant. Most of the oil is excreted by the kidneys, which are also stimulated, and thus buchu is a mild **diuretic.** In the process of excretion it gives a peculiar odour to the urine, and acts as an astringent and **disinfectant to the urinary tract,** especially the bladder. It has consequently been administered for cystitis, irritable bladder, pyelitis, gonorrhœa, &c. Large doses continued for a long time are said to damage the kidneys. The infusion contains very little of the oil. Alcoholic solutions, as the tincture, and a fluid extract which is sold, do not mix well with water on account of the oil in them. The action of buchu is much the same as that of pareira, but it is pleasanter to take, and is a good vehicle for diuretics.

COPAIBA.

Copaiba.—Copaiva. The oleo-resin obtained from the trunk of *Copaifera Lansdorfii* (Nat. Ord. *Leguminosæ*), and other species of *Copaifera.* Valley of the Amazon, West and East Indies.

Characters.—A more or less viscid liquid, generally transparent and not fluorescent, but some varieties are opalescent and slightly fluorescent; light yellow to pale golden brown. Odour peculiar, aromatic; taste acrid, bitter. *Solubility.*—Not at all in water, almost entirely in absolute alcohol, ether, fixed and volatile oils, benzol, and in four times its bulk of petroleum.

Composition.—The chief constituents are—(1) *The official volatile oil,* 48 to 85 per cent. (*see* p. 508). (2) *The resin,* 15 to 52 per cent. It exists dissolved in the oil. Dose, 10 to 20 gr. It is a brown resinous mass consisting of two resins: (*a*) copaivic acid ($C_{10}H_{30}O_2$), the chief constituent, a crystalline resin, with a faint odour, a bitter taste, insoluble in water, easily soluble in absolute alcohol and ammonia; (*b*) a non-crystallizable viscid resin, 1½ per cent.

Impurities.—Turpentine, detected by the smell on heating. Fixed oils; these leave a greasy ring round the resinous stain when heated on paper. Gurjum balsam, which coagulates at 270° F.; copaiba does not.

Dose, ½ to 1 fl. dr. in two and a half times as much mucilage of acacia.

Oleum Copaibæ.

SOURCE.—The volatile oil distilled from copaiba.

CHARACTERS.—Colourless or pale yellow, with the taste and odour of copaiba. Sp. gr. 0·9 to 0·91.

COMPOSITION.—It consists chiefly of a hydrocarbon, $C_{20}H_{32}$.

Dose, 5 to 20 m. suspended in mucilage of acacia (1½ fl. oz. for every fl. oz. of oil of copaiba) or yolk of egg. Cinnamon or peppermint water, with tincture of orange or ginger, covers the taste. It may be dissolved in water with the aid of Liquor Potassæ, with which it forms a soap, or it may be given in capsules.

ACTION.

External.—Copaiba is a stimulant to the skin.

Internal.—*Gastro-intestinal tract.*—It acts like other volatile oils. Small doses produce a feeling of warmth in the epigastrium, but with large doses its irritant effect leads to vomiting and diarrhœa. Its taste is very nasty, and the eructations it may cause are very disagreeable.

Mucous membranes.—Here also it acts like other volatile oils. It is quickly absorbed, and is then excreted by all the mucous membranes, which it stimulates in its passage through them, increasing their vascularity and the amount of their secretion, which if foul is disinfected. Because of these actions it is a disinfectant **expectorant**, and a stimulating **disinfectant** to the whole of the **genito-urinary tract.** It imparts a powerful odour to the breath and mucous secretions. It is also excreted by the skin, and its irritant effect here is seen in the **erythematous rash** it often produces.

Kidneys.—Copaiba has a more marked action on the kidneys than most substances containing volatile oils, and this is in great part due to the resin, which is particularly stimulating to the renal organs, and copaiba is therefore a useful **diuretic.** Large doses of it greatly irritate the kidney, as is shown by pain in the loins and blood and albumen in the urine. The resin itself is excreted in the urine, and can be thrown down from it by nitric acid ; but this precipitate is known not to be albumen by the fact that it is evenly distributed through the fluid and is dissolved by heat. If the renal congestion is severe the urine may be very scanty.

THERAPEUTICS.

Genito-urinary tract.—Copaiba, or more usually its oil, is largely used to stimulate and disinfect this part of the body in cases of pyelitis, cystitis, vaginitis, and gonorrhœa. It is often prescribed for this last disease, and is best given when the acute symptoms have subsided, otherwise it may increase them.

Kidneys.—The resin which remains after distillation of the oil from copaiba is an admirable diuretic for hepatic and cardiac dropsy, but because of its liability to irritate the kidneys should not be given in Bright's disease. After a time patients seem to become accustomed to it, for the diuresis is not so marked as at first. It is nasty and difficult to make palatable. Fifteen grains of the resin with 20 minims of alcohol (90 per cent.), 15 grains of compound tragacanth powder to suspend it, and a fluid drachm of syrup of ginger in an ounce of water may be given for a dose.

Bronchial mucous membrane.—Copaiba is occasionally used as a disinfectant expectorant when the secretion is very foul—as, for example, when the bronchial tubes are dilated.

Skin.—Copaiba has been given in chronic skin diseases, as psoriasis, for the cutaneous stimulation caused by it, but it is now quite discarded.

The reasons why it is rarely used except in gonorrhœa, for which it would not be employed if it had not such a strongly marked beneficial action, are that the smell of the breath of those taking it is very disagreeable, it is very nasty to the taste, and often causes indigestion.

CUBEBS.

Cubebæ Fructus.—Cubebs. The dried unripe full-grown fruit of *Piper cubeba* (Nat. Ord. *Piperaceæ*). Java.

CHARACTERS.—Globular, $\frac{1}{6}$ in. in diameter, blackish or greyish brown, wrinkled, tapering below into a rounded stalk, continuous with the pericarp, in which in the mature fruit is the seed, but in commercial specimens this is often so little developed that the pericarp is almost empty. Odour aromatic. Taste warm, aromatic, bitter. *Resembling cubebs.*—Pepper and pimento; neither has a stalk.

COMPOSITION.—The chief constituents are—(1) *The official volatile oil*, 6 to 15 per cent. (q. v.). (2) An *oleo-resin*, 6 per cent., which contains much cubebic acid and cubebin. (3) Cubebin, a tasteless, insoluble, odourless substance. (4) Cubebic acid. (5) A little piperine.

Dose, 30 to 60 gr.

Preparation.

Tinctura Cubebæ.—Cubebs, 1; alcohol (90 per cent.), 5. Percolate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Oleum Cubebæ.

SOURCE.—The volatile oil distilled from cubebs.

CHARACTERS.—Colourless or greenish yellow, with the odour and taste of cubebs. Sp. gr. 0·91 to 0·93.

COMPOSITION.—The chief constituents are—(1) Cubeben, $C_{15}H_{24}$, a liquid oil. (2) A small amount of a terpene.

Dose, 5 to 20 m. suspended in mucilage.

ACTION.

External.—Like other substances containing a volatile oil, cubebs is rubefacient when rubbed into the skin.

Internal.—Small doses are stomachic and carminative, and improve digestion, but moderate doses are very liable to cause dyspepsia. Cubebs enters the blood, and, like so many volatile oils, slightly stimulates the heart, and also excites the organs through which it is excreted. Occasionally, therefore, it causes an erythematous eruption on the skin; it increases and disinfects the bronchial secretion, and is consequently an expectorant; but its main action is on the **genito-urinary** passages, the mucous membrane of which is powerfully stimulated, and the secretions of which are disinfected. The kidneys are also irritated; hence cubebs is a **diuretic.** It appears in the urine in a form (probably as a salt of cubebic acid) which may be precipitated by nitric acid.

THERAPEUTICS.

It is sometimes employed as lozenges, or as a powder, or as the smoke of cubebs cigarettes, to stimulate the mucous membrane in cases of slight bronchitis, chronic sore throat, or follicular pharyngitis. Chronic nasal catarrh and hay-fever have been treated by insufflations of the powder. Asthma is sometimes relieved by the cigarettes. Many popular bronchial troches contain cubebs; in them it exercises its expectorant action. Cubebs is rarely used as a stomachic or cardiac stimulant, because it is so liable to upset digestion; but as it is less likely to do so than copaiba, is a little pleasanter to take, and is almost as powerful a stimulant to the genito-urinary mucous membrane, it is largely used in gleet, gonorrhœa, and chronic cystitis.

OIL OF SANDAL WOOD.

Oleum Santali.—*Synonym.*—Santal oil. The volatile oil distilled from wood of *Santalum album* (Nat. Ord. *Santalaceæ*). India.

CHARACTERS.—Thick, viscid, pale yellow. Odour strongly aromatic. Taste pungent, spicy. Readily soluble in alcohol, ether, or chloroform. Sp. gr. 0·975 to 0·980.

COMPOSITION.—Not known.

Dose, 5 to 30 m. in capsules, or as an emulsion.

ACTION AND THERAPEUTICS.

The action of sandal-wood oil is the same as that of volatile oils in general, but, like that of the oils of copaiba and cubebs, it is especially manifested in the **genito-urinary mucous membranes**, which are **stimulated and disinfected.** The drug is used in gonorrhœa and gleet; it is pleasanter than copaiba, but more expensive. It appears in the urine half an hour after administration. Some of it is excreted by the bronchial mucous membrane; it is therefore a stimulating disinfectant expectorant. Two or three drops on sugar will frequently relieve the hacking cough so often met with when but little sputum is expectorated.

GROUP VII.

Vegetable Bitters.

All these substances contain a bitter principle, which stimulates the functions of the stomach.

Calumba, Gentian, Quassia, Cascarilla, Chiretta, Cusparia, Serpentary, Cimicifuga, Dandelion, Orange Peel.

CALUMBA.

Calumbæ Radix.—Calumba Root. The dried, transversely cut slices of the root of *Jateorhiza columba* (Nat. Ord. *Menispermaceæ*). From the forests of Eastern Africa north of the Zambesi.

CHARACTERS.—Flat, more or less circular slices, about 2 in. in diameter, and $\frac{1}{8}$ to $\frac{1}{2}$ in. thick. Cortical part thick, with a wrinkled brownish-yellow coat. Centre softer, concave, and greyish yellow; there is a fine dark line between the two parts. Mealy fracture. Musty odour; bitter taste.

COMPOSITION.—The chief constituents are—(1) *Calumbin*, $C_{21}H_{22}O_7$, a neutral bitter principle crystallizing in white needles. (2) Beberine, an alkaloid, giving the yellow colour. (3) Calumbic acid. (4) Starch, 33 per cent. No tannin is present, so calumba can be prescribed with salts of iron.

Preparations.

1. Infusum Calumbæ.—Calumba root, 1; cold water (to avoid extracting the starch), 20.

Dose, $\frac{1}{2}$ to 1 fl. oz.

2. Liquor Calumbæ Concentratus. — Macerated with water, otherwise made like other concentrated liquors. (*See* p. 18.)

Dose, $\frac{1}{2}$ to 1 fl. dr.

3. Tinctura Calumbæ.—Calumba root, 1; alcohol (60 per cent.), 10. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

ACTION.

External.—Calumba is a mild antiseptic and disinfectant.

Internal.—*Mouth.*—Calumba is a typical **bitter**; the appetite is sharpened because the gustatory nerves are stimulated; this reflexly leads to dilatation of the gastric vessels and to an increase in the gastric and salivary secretions.

Stomach.—The effects on the gastric mucous membrane which were brought about reflexly by the stimulation of the gustatory nerves are further exaggerated by the arrival of the saliva in the stomach, and by the direct action of the calumba on it, for although the immediate effect of a bitter in the stomach is to diminish the flow of gastric juice, it is quickly absorbed, and after absorption it has the power to quickly increase the flow of gastric juice. The result of these actions is to cause a feeling of hunger, an extra secretion of gastric juice, and greater vascular dilatation, and all this **helps the digestion** of the food. Peristalsis in the stomach and intestine is made slightly more active, and thus calumba and other bitters are **carminative.** Large doses have a paralytic effect on the secretion, and are very harmful. The long continued use of bitters leads to gastric catarrh and consequent indigestion.

Most of these substances, like volatile oils, cause an increased migration of leucocytes from the intestinal glands into the blood.

Injected up the rectum bitters are **anthelmintic,** destroying the threadworm.

THERAPEUTICS.

Calumba is only employed to stimulate the gastric functions and improve the appetite in cases of chronic indigestion due to a general weakness of action on the part of the stomach. It is thus a type of the large class of stomachics. It is especially valuable in that form of dyspepsia in which the stomach participates in a general feebleness of all the organs of the body, such as we see in anæmia, starvation, convalescence from acute diseases, tuberculosis, and general exhaustion. Bitters should never be used when there is acute or subacute gastritis, a gastric ulcer, or pain. They will obviously make all these conditions worse. They must not be too concentrated, nor be given for too long, lest they should over-irritate the stomach. They should always, as far as possible, be combined with modes of treatment designed to relieve the cause of the dyspepsia. Often they are called tonics; all that is meant by this is that, as they render the digestion of food more easy, the general health will improve. Most bitters, when given as rectal injections, are anthelmintics for the *Oxyuris vermicularis.* Half a pint of the infusion of calumba may be thrown up the rectum of an adult.

GENTIAN.

Gentianæ Radix.—The dried rhizome and roots of *Gentiana lutea* (Nat. Ord. *Gentianaceæ*). Central and Southern European mountains.

CHARACTERS.—Cylindrical, tough, brittle pieces or longitudinal slices, a few inches to a foot or more long, $\frac{1}{2}$–1 in. thick, with irregular longitudinal furrows. The rhizome bears closely approximated leaf scars. Peripherally yellowish brown; centrally reddish yellow. Bark thick, reddish. Wood spongy, separated from bark by dark zone. Odour heavy, peculiar. Taste first sweet, then bitter.

COMPOSITION.—The chief constituents are—(1) *Gentiopicrin*, the active, very bitter glucoside, soluble in water and alcohol. Can be split up into glucose and gentiogenin. (2) Gentisic or gentianic acid united with gentio-picrin. (3) A trace of a volatile oil. (4) Gentianose, a sugar. Gentian contains no tannin, but cannot be prescribed with iron, because that darkens the colouring matter.

INCOMPATIBLES.—Iron salts, silver nitrate, and lead salts.

Preparations.

1. Extractum Gentianæ.—Aqueous.

Dose, 2 to 8 gr.

2. Infusum Gentianæ Compositum.—Gentian, 1; dried bitter orange peel, 1; fresh lemon peel, 2; boiling water, 80.

Dose, ½ to 1 fl. oz.

3. Tinctura Gentianæ Composita.—Gentian, 8; dried bitter orange peel, 3; cardamoms, 1; alcohol (45 per cent.), 80. Macerate.

Dose, ½ to 1 fl. dr.

ACTION AND THERAPEUTICS.

Gentian has the same action as other bitters, such as calumba, and is employed for the same class of cases. It is more used than any other bitter, because its taste is pleasant and it is not astringent.

QUASSIA.

Quassiæ Lignum.—The wood of the trunk and branches of *Picræna excelsa* (Nat. Ord. *Simarubaceæ*). Jamaica.

CHARACTERS.—In billets or logs, varying in size, but often as thick as a man's thigh, and covered with a dark grey bark. Wood dense, tough, porous, yellowish white. Often seen as chips, shavings, or raspings. Inodorous. Intensely bitter. *Resembling quassia.*—Sassafras, but this is aromatic and not bitter.

COMPOSITION.—The chief constituents are—(1) *Quassin*, a bitter neutral principle occurring in crystalline needles. (2) A volatile oil. No tannin is present, and therefore quassia can be prescribed with salts of iron.

Preparations.

1. Infusum Quassiæ.—Quassia, 1; cold water, 100. The water is cold to avoid extracting too much of the bitter principle.

Dose, ½ to 1 fl. oz.

2. Liquor Quassiæ Concentratus. — Made like other concentrated liquors, but only 2 oz. of Quassia to the pint is used, as quassia is so bitter. (*See* p. 18.)

Dose, ½ to 1 fl. dr.

3. Tinctura Quassiæ.—Quassia, 1; alcohol (45 per cent.), 10. Macerate.

Dose, ½ to 1 fl. dr.

ACTION AND THERAPEUTICS.

Quassia is an aromatic bitter stomachic, acting in the same way as calumba. As it contains no tannin it is often prescribed with iron. The only objection to it is that some persons find it too bitter. Injected *per rectum*, it is an excellent anthelmintic for *Oxyuris vermicularis*; half a pint of the infusion may be given for this purpose.

CASCARILLA.

Cascarillæ Cortex.—The dried bark of *Croton Eluteria* (Nat. Ord. *Euphorbiaceæ*). Bahamas.

CHARACTERS.—Quills, 1 to 3 or more in. long, ⅙ to ½ in. in diameter. Externally there is a silvery lichen with black spots, under that a dull brown, easily separable, corky layer. Fracture brown, short, resinous. Odour agreeable, aromatic, especially when burned. Taste warm, bitter. *Resembling cascarilla.*—Pale cinchona, which is less white, smooth and small.

COMPOSITION.—The chief constituents are—(1) *Cascarillin*, a bitter neutral crystalline substance. (2) Volatile oils. (3) Resins. (4) Tannin.

INCOMPATIBLES.—Mineral acids. Lime water. Metallic salts.

Preparations.

1. Infusum Cascarillæ.—1 in 20 of boiling water.

Dose, ½ to 1 fl. oz.

2. Tinctura Cascarillæ.—Cascarilla, 1; alcohol (70 per cent.), 5. Percolate.

Dose, ½ to 1 fl. dr.

ACTION AND THERAPEUTICS.

Because of its bitter principle cascarillin, cascarilla, like other vegetable bitters, improves the digestion, and this stomachic and carminative action is aided by the volatile oils in it. It is pleasant to take, and is suitable for the same cases as calumba. The infusion will not keep good for more than a day unless a tincture is added to it. Mineral acids precipitate the resin from the tincture; therefore the infusion should be prescribed with them.

CHIRETTA.

Chirata.—The dried plant *Swertia chirata* (Nat. Ord. *Gentianaceæ*), collected when in flower. Northern India.

CHARACTERS.—Root 2 to 3 in. long, generally unbranched. Stem 3 ft. or more long, rounded below, quadrangular, winged and much branched above; smooth, orange-brown or purplish; consists of a thin woody ring enclosing much yellow pith. Branches slender, decussate. Leaves opposite, entire, ovate, 5 to 7 ribbed. Flowers small, numerous, panicled. Odour none. Taste very bitter. *Resembling chiretta.*—Lobelia, which is not bitter.

COMPOSITION.—The chief constituents are—(1) *Chiratin*, an active bitter, amorphous principle. (2) Ophelic acid, with which it is combined. No tannin is present.

Preparations.

1. **Infusum Chiratæ.**—1 in 20 of boiling water.
Dose, ½ to 1 fl. oz.

2. **Liquor Chiratæ Concentratus.**—Made in the usual way for concentrated liquors. (*See* p. 18.)
Dose, ½ to 1 fl. dr.

3. **Tinctura Chiratæ.**—Chiretta, 1; alcohol (60 per cent.), 10. Percolate.
Dose, ½ to 1 fl. dr.

ACTION AND THERAPEUTICS.

Chiretta has the same actions and uses as gentian, calumba, and other bitters. As it contains no tannin, it can be given with iron. It is more used in India than in England.

CUSPARIA.

Cuspariæ Cortex.—Cusparia bark. *Synonym.*—Angustura bark. The dried bark of *Cusparia febrifuga* (Nat. Ord. *Rutaceæ*). From tropical South America.

Characters.—Flat or curved pieces or quills, 6 in. or less long, 1 in. wide, $\frac{1}{12}$ in. thick. Externally a yellowish grey, mottled, corky layer, which can be scraped off, and shows a dark brown resinous layer; inner surface light brown, flaky. Fracture short, resinous, and showing under a lens white points or lines. Taste bitter, aromatic. Odour musty, disagreeable.

Impurity.—Bark of *Strychnos nux-vomica* (false Angustura bark): its inner surface gives bright blood-red colour with nitric acid, showing brucine; cusparia does not.

Composition.—The chief constituents are—(1) *Cusparine*, or angusturine, a crystalline bitter alkaloid. (2) An alkaloid, galipeine. (3) An alkaloid galipidene. (4) An alkaloid cusparidine. (5) An aromatic oil. It is stated that no tannin is present, but iron salts are incompatible with cusparia.

Incompatibles.—Mineral acids and metallic salts.

Preparations.

1. Infusum Cuspariæ.—1 in 20 of boiling water. **Dose, 1 to 2 fl. oz.**

2. Liquor Cuspariæ Concentratus.—Made in the usual way for concentrated liquors. (*See* p. 18.) **Dose, $\frac{1}{2}$ to 1 fl. dr.**

Action and Therapeutics.

Cusparia bark is an aromatic bitter, having a similar action to calumba. It is used to make Angustura Bitters. In South America it is given as an antiperiodic.

SERPENTARY.

Serpentariæ Rhizoma.—Serpentary Rhizome. The dried rhizome and rootlets of *Aristolochia serpentaria*, or of *Aristolochia reticulata* (Nat. Ord. *Aristolochiaceæ*). North America.

Characters.—The rhizome of A. serpentaria is $\frac{1}{8}$ in. thick, 1 in. long. Upper surface, remains of former stems; under surface, a tuft of slender rootlets, 1 to 4 in. long. Dull yellowish brown. Odour aromatic, camphoraceous; taste bitter, aromatic, camphoraceous. The rhizome and roots of A. reticulata resemble the foregoing but are longer and thicker. *Resembling serpentary.*—Arnica, valerian (q. v.). The rhizome deteriorates by keeping.

Composition.—The chief constituents are—(1) A bitter principle, aristolochin. (2) A volatile oil. (3) Resin.

Preparations.

1. **Infusum Serpentariæ.**—1 in 20 of boiling water.
Dose, ½ to 1 fl. oz.

2. **Liquor Serpentariæ Concentratus.**—Made in the usual way for concentrated liquors. (*See* p. 18.)
Dose, ½ to 2 fl. dr.

3. **Tinctura Serpentariæ.**—Serpentary, 1; alcohol (70 per cent.), 5. Percolate.
Dose, ½ to 1 fl. dr.

Serpentary is contained in Tinctura Cinchonæ Composita.

Action and Therapeutics.

In the small doses in which serpentary is given in medicine it is a bitter stomachic, acting just like calumba, cascarilla, &c., and it is used for the same class of cases. It is rarely prescribed alone. In large doses it produces vomiting and purging. Many virtues have been attributed to it which it does not possess.

CIMICIFUGA.

Cimicifugæ Rhizoma.—Cimicifuga Rhizome. The dried rhizome and roots of *Cimicifuga racemosa* (also called *Actæa racemosa*). The black snake-root or black cohosh (Nat. Ord. *Ranunculaceæ*). Northern United States.

Characters.—Rhizome 2 to 6 in. long, ½ to 1 in. thick Hard, brownish black, almost odourless; bitter taste. On the upper surface remains of stout ascending branches; on the lower, wiry, brittle, branched rootlets, more or less broken off. It deteriorates by keeping.

Composition.—The chief constituents are—(1) A volatile oil. (2) Tannic and gallic acids. (3) Two resins.

Cimicifugin or macrotin is an impure resin deposited from the tincture on adding water.

Preparations.

1. Extractum Cimicifugæ Liquidum.—Powdered cimicifuga, 1; alcohol (90 per cent.), 1.

Dose, 5 to 30 m.

2. Tinctura Cimicifugæ.—Powdered cimicifuga, 1; alcohol (60 per cent.), 10. Percolate.

Dose, 30 to 60 m.

ACTION.

Cimicifuga has two chief actions. It influences the gastric secretion like any other bitter, and, to a slight extent, it depresses the rate but increases the force of the pulse, like digitalis. The arterial tension rises. It is said to cause contractions of the uterus and to increase the menstrual flow.

THERAPEUTICS.

It has been used for chorea, dyspepsia, bronchitis, amenorrhœa, rheumatism, neuralgia, and many other diseases. The evidence that it does much good is slight.

DANDELION ROOT.

Taraxaci Radix.—The fresh and dried roots of *Taraxacum officinale* (Nat. Ord. *Compositæ*). Collected in the autumn.

CHARACTERS.—About 12 in. long, ½ in. in diameter. When fresh is externally smooth, yellowish brown. Internally white. Short fracture. Milky juice. When dried is dark brown, furrowed longitudinally, shrivelled. Fracture short, showing yellow, porous, woody axis, with irregular concentric rings and a thick whitish bark. No odour. Taste bitter. *Resembling taraxacum.*—Pellitory, which is pungent when chewed.

COMPOSITION.—The chief constituents are—(1) Taraxacin, a neutral principle. (2) Taraxacerin. (3) Asparagin (found also in asparagus, marsh-mallow, liquorice, euonymus, &c.), of no therapeutical value. (4) Inulin, mannite. (5) Salts. (6) Resins (which give the juice its milky appearance).

Preparations.

1. Extractum Taraxaci.—Fresh extract. Made with *fresh root.*

Dose, 5 to 15 gr.

2. Extractum Taraxaci Liquidum.—*Dried root*, extracted with alcohol (60 per cent.) and water.

Dose, ½ to 2 fl. dr.

3. Succus Taraxaci.—*Fresh juice*, 3; alcohol (90 per cent.), 1.

Dose, 1 to 2 fl. dr.

ACTION AND THERAPEUTICS.

Dandelion is a simple bitter, and acts as a stomachic, just like calumba. It is also slightly laxative. It was formerly much more used than at the present day. It has been said to stimulate the flow of bile, but this is incorrect.

ORANGE PEEL.

Aurantii Cortex Recens.—Fresh Bitter Orange Peel. The fresh outer part of the pericarp of *Citrus Aurantium* (var. *Bigaradia*) (Nat. Ord. *Rutaceæ*).

CHARACTERS well known.

Preparations.

1. Tinctura Aurantii.—Fresh bitter orange peel, 1; alcohol (90 per cent.), 4. Macerate.

Dose, ½ to 1 fl. dr.

2. Syrupus Aromaticus.—Tincture of orange, 1; cinnamon water, 1; syrup, 2. *Synonym.*—Simple Elixir.

Dose, ½ to 1 fl. dr.

3. Syrupus Aurantii.—Tincture of orange, 1; syrup, 7.

Dose, ½ to 1 fl. dr.

4. Vinum Aurantii.—A saccharine solution to which fresh bitter orange peel has been added is fermented. It contains 10 to 12 per cent. of alcohol.

Vinum Aurantii is used to make Vinum Ferri Citratis and Vinum Quininæ.

Tinctura Aurantii is contained in Confectio Sulphuris, Syrupus Cascaræ Aromaticus, Tinctura Quininæ, and Trochisci Sulphuris.

Aurantii Cortex Siccatus.—Dried Bitter Orange Peel. The dried outer part of the pericarp of *Citrus Aurantium* (var. *Bigaradia*) (Nat. Ord. *Rutaceæ*).

CHARACTERS.—Thin pieces or strips, dark yellow colour, almost free from the white inner rind. Odour fragrant. Taste aromatic and bitter.

Composition.—The chief constituents are—(1) A fixed oil, *Oleum Corticis Aurantii*, 1 to 2 per cent. Sp. gr. 0·84 to 0·86, which consists chiefly of a terpene, dextro-rotatory limonene, $C_{10}H_{16}$. This oil is an ingredient of several elixirs. (2) Three glucosides, hesperidin, isohesperidin, aurantiamarin (the bitter principle).

Preparations.

1. **Infusum Aurantii.**—Dried bitter orange peel, 1; boiling water, 20.

Dose, ½ to 1 fl. oz.

2. **Infusum Aurantii Compositum.**—Dried bitter orange peel, ½ oz.; fresh lemon peel, ¼ oz.; cloves, 55 gr.; boiling water, 20 fl. oz.

Dose, ½ to 1 fl. oz.

Dried bitter orange peel is contained in Spiritus Armoraciæ Compositus, Tinctura Cinchonæ Composita, Infusum Gentianæ Compositum, Tinctura Gentianæ Composita.

Aqua Aurantii Floris.—Orange Flower Water. The orange flower water of commerce prepared by distillation from the flowers of *Citrus Aurantium* (var. *Bigaradia*) (the bitter orange tree). It is a saturated solution of the essential oil of the fresh flowers. In dispensing it is diluted with twice its volume of distilled water immediately before use.

Characters.—Colourless or slightly greenish; very fragrant; bitter taste.

Composition.—The chief constituents are—(1) A volatile oil, *Oleum Neroli*. (2) A bitter principle.

Dose, ½ to 1 fl. oz.

Preparation.

Syrupus Aurantii Floris.—Orange flower water of commerce, undiluted, 8 fl. oz.; sugar, 3 lbs.; water to make 4½ lbs.

Dose, ½ to 1 fl. dr.

Orange flower water, undiluted, is contained in Mistura Olei Ricini, and in Syrupus Calcis Lactophosphatis.

Action and Therapeutics.

The various preparations of the orange are used largely as flavouring agents, and Syrupus Aromaticus is especially useful. They are slightly bitter and stomachic.

GROUP VIII.

Vegetable Drugs containing Tannic Acid.

These are all astringent.

Oak Galls, Catechu, Rhatany, Kino, Logwood, Hamamelis, Eucalyptus Gum.

TANNIC AND GALLIC ACIDS.

Galla.—Galls. Excrescences on *Quercus infectoria* (Nat. Ord. *Cupuliferæ*), caused by the puncture and deposit of an egg or eggs of *Cynips gallæ tinctoriæ*.

Characters.—Hard, heavy, subglobular, ½ to ¾ in. in diameter; tuberculated on surface; the tubercles and the intervening spaces are smooth; dark bluish green or dark olive-green externally; yellowish or brownish white within, with small central cavity. Odour none. Taste first astringent, then sweetish.

Composition.—The chief constituents are—(1) *Tannic acid*, 25 to 75 per cent. (2) *Gallic acid*, 2 to 5 per cent.

Incompatibles, *see* Tannic and Gallic Acids.

Preparations.

1. **Unguentum Gallæ.**—Galls, 1; benzoated lard, 4.

2. **Unguentum Gallæ cum Opio.**—Ointment of galls, 925 gr.; opium, 75 gr.

Acidum Tannicum.—Tannic Acid. *Synonyms.*—Tannin, Digallic acid. $C_{14}H_{10}O_9,2H_2O$.

Source.—Tannic acid may be extracted by water saturated with ether from galls which have been subjected to a special fermentation.

Characters.—A pale brownish powder, consisting of thin glistening scales. Taste strongly astringent. Reaction acid. *Solubility.*—Freely in water or alcohol (90 per cent.); 1 in 1 of glycerin; 1 in 100 of ether. Gives a yellowish-white precipitate with gelatin (gallic acid does not), and this is the action that takes place when hides are tanned. There are many varieties of tannic acid in pharmacopœial plants. They mostly exist in glucosides.

INCOMPATIBLES.—Mineral acids, alkalies. Salts of antimony, lead, silver, per-salts of iron. Alkaloids, gelatin, emulsions.

Preparations.

1. **Glycerinum Acidi Tannici.**—1 in 6.
2. **Suppositoria Acidi Tannici.** — Tannic acid, 3 gr.; oil of theobroma, 12 gr. in each.
3. **Trochiscus Acidi Tannici.**—½ gr. in each, with a fruit basis.

ACTION.

External.—Tannic acid is one of our most important drugs, because it coagulates albumen and gelatin with great readiness; that is to say, it tans the tissues, for it is by coagulating the interstitial fluids in skins that tannic acid converts them into leather. If an albuminous discharge is taking place from a sore or mucous surface and tannic acid is applied, the excreted fluid is coagulated, and the dense, insoluble coagulum forms a solid protecting layer which prevents further discharge. As the tannic acid soaks into the tissues it coagulates the albuminous fluids there also, and this still further hinders the discharge of fluid, therefore it is an energetic **astringent.** If bleeding is taking place, tannic acid of course coagulates the blood as it flows and the clots plug the vessels; at the same time the coagulum formed within the tissues, by its contraction, constricts the blood-vessels, and thus tannic acid becomes a powerful **hæmostatic.** Authorities differ as to whether it also contracts the blood-vessels by acting directly on them like lead, silver, ergot, &c., but probably it has no such action. Tannic acid is slightly antiseptic, and it is mildly depressant to sensory nerves. Like other acids it is irritant, but it is very feebly so, and consequently its action in this direction is more than counterbalanced by its strongly astringent effects.

Internal.—*Gastro-intestinal tract.*—Because tannic acid coagulates the mucous secretions and the fluids in mucous membranes, it makes the mouth dry when locally applied; in the stomach it prevents the secretion of gastric juice, and decreases the flow of mucus. For these reasons, and also because it precipitates pepsin, it interferes with digestion. It will check gastric hæmorrhage. In the intestine it is either **converted into gallic acid** or forms alkaline tannates, and until these alterations it acts as an intestinal astringent, controlling intestinal bleeding; but this acid and these salts have no astringent properties unless the tannates are decomposed by an acid, therefore when drugs containing large amounts of tannic acid act as powerful intestinal astringents and hæmostatics, we must suppose that the amount of tannic acid taken is large enough for the conversion of it into salts or gallic acid, to take place slowly.

It is absorbed as gallic acid and alkaline tannates.

Remote effects.—Gallic acid and undecomposed alkaline tannates circulate in the blood, but they have no power to coagulate albumen, nor have they any astringent influence when locally applied, therefore it is difficult to believe that tannic acid has any remote astringent or hæmostatic effects; some claim that it has, but they have not proved their case. It is excreted in the urine of animals as gallic acid, but in man no derivative of it can be detected in the urine, so it is either not excreted in this fluid or it is entirely decomposed in the body. Many vegetable substances, as logwood, &c., depend, for their astringent properties, on the tannic acid they contain.

THERAPEUTICS.

The therapeutical applications of tannic acid are very numerous. It is used as an astringent for ulcers, sores, various moist eruptions, tonsillitis, pharyngitis, nasal catarrh, otorrhœa, gastric catarrh, diarrhœa (large doses of 30 grains may be given and catechu, logwood, &c., are favourite remedies), leucorrhœa, gonorrhœa, rectal ulcers, fissures, and prolapse, &c. It is employed as a hæmostatic in bleeding from small wounds, ulcers, the gums, the pharynx, the nose, the stomach, the intestine, hæmorrhoids, the bladder, &c. Whenever practicable a good method of application is to dust it on the part, especially for hæmorrhage; if this is gastric or intestinal 30 grains or more should be frequently given by the mouth. For external use or for application to the throat the glycerinum is useful. A gargle of 1 fl. dr. of the glycerinum to 1 fl. oz. of water may be made. The lozenges are convenient for pharyngitis. A spray (6 to 10 gr. in 1 fl. oz. of water) or an insufflation of tannic acid and starch may be used for the mouth and larynx. The ointment of galls and opium is a favourite application for piles. The suppositories are useful for rectal discharges. Solutions of 10 gr. to 1 fl. oz. of water may be injected into the urethra for gonorrhœa and urethritis, and into the bladder for cystitis. The decoction of oak bark, employed as a rectal injection, destroys the threadworm.

Acidum Gallicum.—Gallic Acid. *Synonym.*—Trihydroxy-benzoic acid. $C_6H_2(OH)_3COOH,H_2O$.

SOURCE.—Boil one part of powdered galls with four parts of dilute sulphuric acid, and strain. Gallic acid crystallizes out, having been hydrolysed from the tannic acid in the galls.

CHARACTERS.—White or pale acicular prisms or silky needles. Taste acid. *Solubility.*—1 in 100 of cold water; 1 in 3 of boiling water; 1 in 5 of alcohol (90 per cent.); 1 in 5 of cold, 1 in 4 of hot glycerin.

INCOMPATIBLES.—Per-salts of iron, and metallic salts generally; Spiritus Ætheris Nitrosi.

Dose, 5 to 15 gr.

ACTION.

Gallic acid has no power to coagulate albumen, and therefore possesses none of the local properties of tannic acid. If it is wished to try to produce the supposed remote astringent effects of tannic acid, gallic acid may be administered, for tannic acid is in the intestine converted into it.

Acidum Pyrogallicum.—(Not official.)
Synonym.—Pyrogallol. $C_6H_3(OH)_3$.

SOURCE.—Obtained by heat from gallic or tannic acid.

CHARACTERS.—Light, small, white crystals. Odour none. *Taste.*—It produces a feeling of coldness on the tongue. *Solubility.*—1 in 2½ of water; 1 in 10 of lard.

ACTION AND THERAPEUTICS.

It is used externally as an ointment (Jarisch's ointment is pyrogallic acid, 60 gr.; lard, 1 oz.) for the treatment of chronic psoriasis. Jarisch's ointment is very strong; a more usual strength is 10 or 20 gr. to an ounce of lard. Pyrogallic acid is also an excellent parasiticide for ringworm. It must not be applied over too large a surface, as it may be absorbed and produce toxic symptoms.

CATECHU.

Catechu. *Synonyms.*—Pale catechu, Catechu Pallidum. An extract of the leaves and young shoots of *Uncaria Gambier* (Nat. Ord. *Rubiaceæ*). Prepared at Singapore and other places in the Eastern Archipelago.

CHARACTERS.—In cubes (sometimes agglutinated), each side 1 in., deep reddish brown externally, pale brown internally; dull, earthy fracture, under the microscope showing myriads of small acicular crystals. Odourless. Taste at first astringent, bitter, then sweet. Entirely soluble in boiling water.

COMPOSITION.—The chief constituents are—(1) *Catechu-tannic acid*, 40 per cent., the active principle, isomeric with catechin, and converted into it by boiling or by the saliva, a red colour being formed. (2) Catechin or catechuic acid, probably inactive. (3) Pyrocatechin or catechol, $C_6H_4(OH)_2$, gives a green colour with ferric chloride. Pyrocatechin is found pathologically in the urine and gives it a dark colour.

INCOMPATIBLES.—Alkalies, metallic salts, and gelatin.

IMPURITY.—Starch.

Dose, 5 to 15 gr.

Preparations.

1. **Pulvis Catechu Compositus.**—Catechu, 4; kino, 2; rhatany, 2; cinnamon, 1; nutmeg, 1. *Strength* of catechu, 4 in 10.

Dose, 10 to 40 gr.

2. **Tinctura Catechu.**—Catechu, 4; cinnamon, 1; alcohol (60 per cent.), 20. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

3. **Trochiscus Catechu.**—1 gr. in each with a simple basis.

ACTION AND THERAPEUTICS.

Catechu is a powerful **astringent**, acting in virtue of its tannic acid, and having a precisely similar action to it. It is used as a lozenge for sore throats, and the other preparations, especially the compound powder, are very efficacious for diarrhœa.

Catechu, Black.—(Not official.)
An extract from the heart-wood of *Acacia catechu.* Blackish-brown masses almost insoluble in water. It is the form of catechu in the pharmacopœias of all countries but Great Britain, as it has the same action as, but is much more constant and powerful than, the official pale catechu.

Dose, 5 to 15 gr. in powder.

RHATANY.

Krameriæ Radix.—Krameria Root. *Synonym.*—Rhatany Root. The dried root of (1) Para Rhatany, a species of Krameria attributed to Krameria argentea; or of (2) Peruvian Rhatany, Krameria triandra (Nat. Ord. *Polygalaceæ*).

CHARACTERS.—(1) Para. — Cylindrical pieces, purplish-brown, smooth thick bark which adheres closely to the wood and has deep cracks. Wood, fracture short, colour reddish-brown. (2) Peruvian.—Dark reddish-brown yellow, woody axis. The bark separates easily, is thinner than of Para, mostly rough and scaly. The bark of both kinds is strongly astringent, and tinges the saliva red.

COMPOSITION.—The chief constituents are—(1) *Rhatanhia-tannic acid*, 20 per cent. (2) Rhatanhia red, the colouring matter. (3) Rhatannin, a neutral substance.

INCOMPATIBLES.—Alkalies, lime water, salts of iron and lead, and gelatin.

Preparations.

1. Extractum Krameriæ.—Aqueous.

Dose, 5 to 15 gr.

2. Infusum Krameriæ.—1 in 20 of boiling water.

Dose, $\frac{1}{2}$ to 1 fl. oz.

3. Liquor Krameriæ Concentratus.— Made in the usual way for concentrated liquors. (*See* p. 18.)

Dose, $\frac{1}{2}$ to 1 fl. dr.

4. Pulvis Catechu Compositus.—Catechu, 4; kino, 2; krameria, 2; cinnamon, 1; nutmeg, 1.

Dose, 10 to 40 gr.

5. Tinctura Krameriæ.—Powdered krameria root, 1; alcohol (60 per cent.), 5. Percolate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

6. Trochiscus Krameriæ.—1 gr. of the extract of krameria in each with a fruit basis.

7. Trochiscus Krameriæ et Cocainæ.—1 gr. of the extract of krameria and $\frac{1}{20}$ gr. of cocaine hydrochloride in each with a fruit basis.

ACTION.

The action of rhatany is due entirely to the tannic acid it contains. It is therefore a powerful **astringent.**

THERAPEUTICS.

The powdered extract is the important ingredient of many tooth powders which are useful when the gums are liable to bleed. The infusion is an excellent gargle for a relaxed throat, and the lozenges are also efficacious, those of rhatany and cocaine being specially serviceable. Bleeding from the nose or the rectum may be stopped by applying powdered rhatany root locally; the infusion may be used as an injection in leucorrhœa and gonorrhœa. Any of the preparations, especially the compound catechu powder, are powerful astringents for all varieties of diarrhœa, and may be taken to stop bleeding from the stomach and intestines. They are also given as remote hæmostatics for hæmoptysis and hæmaturia, but they are not reliable for these purposes.

KINO.

Kino.—The juice obtained from incisions into the trunk of *Pterocarpus marsupium* (Nat. Ord. *Leguminosæ*), evaporated to dryness. Malabar.

CHARACTERS.—Small, angular, glistening, reddish-black, brittle fragments. In thin pieces, and at the edges translucent and ruby-red. Inodorous. When chewed, sticks to the teeth and colours the saliva blood-red. *Solubility.*—Easily in alcohol (90 per cent.), also in boiling water, partially in cold.

COMPOSITION.—The chief constituents are—(1) *Kino-tannic acid*, 75 per cent. (2) Kinoin, a crystalline neutral substance. (3) Pyrocatechin, $C_6H_4(OH)_2$ (*see* p. 527). (4) Kino red, formed from kino-tannic acid by oxidation. (5) Gum.

INCOMPATIBLES.—Mineral acids, alkalies, all metallic salts, carbonates, gelatin.

Dose, 5 to 20 gr.

Preparations.

1. **Pulvis Kino Compositus.** — Kino, 15; opium, 1; cinnamon, 4; *Strength*, 1 of opium in 20.
Dose, 5 to 20 gr.

2. **Tinctura Kino.** — Kino, 2; glycerin, 3; water, 5; alcohol (90 per cent.), 12. Macerate.
Dose, ½ to 1 fl. dr.

3. **Pulvis Catechu Compositus.**—2 in 10 (*see* p. 528).

ACTION AND THERAPEUTICS.

Kino-tannic acid acts like tannic acid, and therefore kino is a powerful astringent. It is used in astringent gargles, and also in diarrhœa mixtures.

LOGWOOD.

Hæmatoxyli Lignum.—Logwood. The heart-wood of *Hæmatoxylon campechianum* (Nat. Ord. *Leguminosæ*). Campeachy, Honduras, and Jamaica.

CHARACTERS.—The logs, in which form it is imported, are hard, heavy, orange or purple red externally, and internally reddish brown. The chips are reddish brown. Odour agreeable, peculiar. Taste sweetish, astringent. When chewed the saliva is coloured reddish pink. *Resembling logwood.*—Red sanderswood, which is more dense and less astringent.

Composition.—The chief constituents are—(1) *Tannic acid.* (2) Hæmatoxylin, $C_{16}H_{11}O_6$, 12 per cent. Occurring in colourless crystals, which become dark red on exposure to light. Solutions of it are used to stain histological specimens.

Incompatibles.—Mineral acids, lime water, and tartar emetic; metallic salts give a blue colour.

Preparation.

Decoctum Hæmatoxyli.—Logwood, 1 oz.; cinnamon bark, 70 gr.; water, 20 fl. oz.
Dose, ½ to 2 fl. oz.

Action and Therapeutics.

In virtue of its tannic acid logwood is a powerful **astringent**, and for this purpose is used to control diarrhœa of all sorts. It may be combined with other astringents, as chalk and opium. It does not easily produce constipation. It colours the urine and fæces dark red. One disadvantage of it is that it stains linen if dropped on it.

HAMAMELIS.

Hamamelidis Cortex.—The dried bark o *Hamamelis virginiana*, the witch-hazel (Nat. Ord. *Hamamelaceæ*). United States.

Characters.—Curved pieces 6 to 8 in. long, $\frac{1}{16}$ in. thick. Scaly, silver-grey outer bark marked with lenticels, but often free from outer bark and then smooth reddish brown. Interior bright brownish red, striated longitudinally. Taste astringent.

Composition.—The chief constituents are—(1) *Tannic acid*, 8 per cent. (2) A volatile principle not yet isolated. (3) A little colouring matter.

Preparation.

Tinctura Hamamelidis.—Hamamelis bark, 1; alcohol (45 per cent.), 10. Percolate.
Dose, ½ to 1 fl. dr.

Hamamelidis Folia.—The fresh and dried leaves of *Hamamelis virginiana*.

Characters.—3 to 6 in. long, 3 to 4 in. broad, oval, apex obtuse, oblique at the base, dark brown green above, pale below.

Veins prominent. Odour slightly tea-like. Taste astringent, bitter.

Composition.—The same as of the bark, but the leaves contain rather less tannin. The fresh are more active than the dried.

Preparations.

1. Extractum Hamamelidis Liquidum.—Hamamelis leaves, powdered, 20 oz., percolated with alcohol (45 per cent.), 20 fl. oz.

Dose, 5 to 15 m.

2. Liquor Hamamelidis.—Fresh leaves, 5; water, 10; alcohol (90 per cent.), 1. Macerate and distil.

3. Unguentum Hamamelidis.—The liquid extract, 1; hydrous wool fat, 9.

Action and Therapeutics.

Hamamelis is, because of its tannic acid, **astringent and hæmostatic.** The liquid extract or the tincture is used for capillary hæmorrhage from wounds, for bleeding from the nose, the sockets of the teeth, the gums, or from piles, and either may be injected into the bladder in vesical hæmorrhage. For all these purposes they are diluted with water; the fluid may be any strength; 1 of the tincture to 10 or 20 of water is commonly employed. Locally applied, hamamelis, either as the ointment or a dilute fluid preparation, such as the liquor, is used as an astringent in bruises, sprains, pharyngitis, and nasal catarrh. The ointment is often used for piles. Given by the mouth, hamamelis may check diarrhœa, dysentery, &c.; and it is reputed to be a remote hæmostatic and astringent, but this is probably incorrect. Hazeline is a distilled extract from the leaves.

EUCALYPTUS GUM.

Eucalypti Gummi. *Synonym.*—Red gum. A ruby-coloured exudation from the bark of *Eucalyptus rostrata* (Nat. Ord. *Myrtaceæ*) and some other species of eucalyptus. Australia.

Characters. — Semi-translucent and garnet-coloured grains or small masses. Tough and difficult to powder.

Adheres to the teeth when chewed. Taste very astringent. Soluble in water. *Resembling eucalyptus gum.*—Kino, which is darker and feebly soluble in water.

COMPOSITION.—The chief constituents are—(1) *Kinotannic acid.* (2) Catechin. (3) Pyrocatechin (*see* p. 527).

Dose, 2 to 5 gr.

Preparation.

Trochiscus Eucalypti Gummi.—1 gr. in each with a fruit basis.

ACTION AND THERAPEUTICS.

Red gum is, in virtue of its tannic acid, powerfully **astringent**, and is used for diarrhœa and dysentery. The lozenges, or a decoction of 1 in 40 as a gargle, are employed for relaxed throats. This decoction may also be given in doses of 2 to 4 fl. dr. for diarrhœa. A liquid extract (red gum, 7; water, 21; alcohol (90 per cent.), 1: dose, $\frac{1}{2}$–1 fl. dr.) is a useful preparation. Injected into the nose it stops epistaxis. Mixed with 1 in 10 of water it may be injected into the rectum or vagina, or may be used as a mouth wash. Suppositories, each containing 5 gr. of red gum, are prepared, and may be employed for piles.

Coto Cortex.—(Not official.)

A bark obtained from Bolivia, species undetermined.

CHARACTERS.—Flat or curved pieces, 12 in. long, $\frac{3}{4}$ in. broad, of a cinnamon-brown colour. Its active principle is said to be cotoine, a glucoside. Coto is placed here, among the drugs containing tannic acid, provisionally until its composition is known.

Preparation (Brit. Pharm. Conference).

Tinctura Coto.—Coto, 1; alcohol (90 per cent.), 10.

Dose, 10 m. every 2 hours (with mucilage and syrup to suspend the large amount of resin which it contains, and which is precipitated by the addition of water).

ACTION.

Coto is employed to check diarrhœa.

GROUP IX.

Vegetable Demulcent Substances.

Many of these are nutritive.

Olive oil, soap, glycerin, oleic acid, almonds, tragacanth, gum acacia, liquorice, linseed, sugar, malt, soya beans.

OLIVE OIL.

Oleum Olivæ.—The oil expressed from the ripe fruit of *Olea europæa* (Nat. Ord. *Oleaceæ*). South Europe.

CHARACTERS.—A pale yellow or greenish yellow fluid. Odour faint. Taste oleaginous. Sp. gr. 0·914–0·919.

COMPOSITION.—The two constituents are—(1) *Triolein*, 72 per cent., a fluid oil, a compound of oleic acid and glyceryl, thus: $C_3H_5(C_{18}H_{33}O_2)_3$. (2) *Tripalmitin*, 28 per cent., a solid oil, a compound of palmitic acid and glyceryl, $C_3H_5(C_{16}H_{31}O_2)_3$. The formula for oleic acid is $C_{18}H_{34}O_2$; and for palmitic, $C_{16}H_{32}O_2$.

Dose, ½ to 1 fl. oz.

Olive oil is contained in many plasters, ointments, and liniments. From it are made hard soap, soft soap, and glycerin.

ACTION AND THERAPEUTICS.

External.—Olive oil is used to facilitate the rubbing of parts; for this purpose it is employed in massage. It is a common soothing protective to burns (*see* Linimentum Calcis, p. 144), and may be mixed with poultices to prevent their sticking to the skin. If rubbed in vigorously, it can be absorbed through the epidermis, and might be thus used as a food when nourishment cannot be given by the mouth.

Internal.—For its soothing protective qualities it may be swallowed after corrosive poisons have been taken. It is an excellent mild laxative, and can be given with food for this purpose. Some persons like it, with others it excites nausea and vomiting. An olive oil enema (olive oil, 4 fl. oz.; warm mucilage of starch, 8 fl. oz.) is often used to open the bowels when a mild non-irritating injection is required.

A gall stone placed in pure olive oil at the temperature of the body is slowly dissolved, because cholesterin, which is the chief constituent of gall stones, is soluble in olive oil. It is also soluble in oleic acid and in animal soaps. Many patients suffering from gall stones derive much benefit from taking olive oil. This is chiefly because the oil or some of its constituents are excreted by the bile, and to a much less extent because the intestinal peristalsis set up by the olive oil extends to the bile ducts. From 2–8 fl. oz. should be taken daily. It may be mashed with fish or potato. Some people take it better if a few grains of menthol and a drachm of brandy are added to each 8 fl. oz. of oil.

Olive oil is a food, but it is not often used in this country as such. The history of fats and oils in the body is discussed in works on physiology.

SOAP.

Sapo Durus.—Hard soap. It is sodium oleate, $NaC_{18}H_{33}O_2$, containing 30 per cent. of water. It is rarely pure, almost always containing some alkaline hydroxide or carbonate.

Source.—Made by acting on olive oil with caustic soda. $C_3H_5(C_{18}H_{33}O_2)_3 + 3NaHO = 3NaC_{18}H_{33}O_2$ (hard soap) + $C_3H_5(OH)_3$ (glycerin).

Preparations.

1. **Emplastrum Saponis.**—Hard soap, 6; lead plaster, 36; resin, 1.
2. **Pilula Saponis Composita.**—Opium, 1; hard soap, 3; syrup of glucose, 1 (*see* Opium, p. 311).
   Dose, 2 to 4 gr.

Hard soap is used to make many pills.

Sapo Mollis.—Soft Soap. It is potassium oleate, $KC_{18}H_{33}O_2$. It is rarely pure, almost always containing some alkaline hydroxide or carbonate.

Source.—Made by acting on olive oil with caustic potash. $C_3H_5(C_{18}H_{33}O_2)_3 + 3KHO = 3KC_{18}H_{33}O_2 + C_3H_5(OH)_3$(glycerin).

Preparation.

Linimentum Saponis. *Synonym.*—Opodeldoc.

Soft soap, 16 ; camphor, 8 ; oil of rosemary, 3 ; alcohol (90 per cent.), 128 ; water, 32.

Soft soap is contained in Linimentum Terebinthinæ. *Linimentum Saponis is contained in* Linimentum Opii. For Sapo Animalis *see* p. 586.

USES.

Hard soap forms a basis for many pills and for the plaster of it. Soft soap is a basis for the liniment of it. Either variety is frequently made into a lather with about a pint of water at 100° F. and used as a purgative enema. Soft soap is to be preferred ; about 1 fl. oz. is commonly used.

GLYCERIN.

Glycerinum.—Glycerin. $C_3H_5(OH)_3$. *Synonym.*—Glycerol. It is a trihydric alcohol. It is always associated with a little water.

SOURCE.—It is obtained by the interaction of alkalies or of superheated steam with fats and fixed oils (*see* pp. 4 and 535).

CHARACTERS.—These are well known. It is miscible with water and alcohol. Its sp. gr. is 1·26. It is formed in the making of lead plaster (*see* p. 154).

Dose, 1 to 2 fl. dr.

Preparations.

1. Glycerinum Acidi Borici. — *Synonym.*—Boroglyceride.—Powdered boric acid; glycerin, q. s.; heat gently.

2. Glycerinum Acidi Carbolici. — Carbolic acid, 1 ; glycerin, 5.

3. Glycerinum Acidi Tannici.—Tannic acid, 1 ; glycerin, 5.

4. Glycerinum Aluminis.—Alum, 1 ; glycerin, 6 ; distilled water, $\frac{3}{8}$; heat gently if necessary.

5. Glycerinum Amyli.—Starch, 1 ; glycerin, $6\frac{1}{2}$; water, $1\frac{1}{2}$; heat to form a jelly.

6. Glycerinum Boracis.—Borax, 1 ; glycerin, 6.

7. Glycerinum Pepsini.—Pepsin, 800 gr. ; hydrochloric acid, 110 ♏ ; glycerin, 12 fl. oz. ; distilled water to 20 fl. oz. *Strength*, 1 fl. dr. represents 5 gr. of pepsin.

Dose, 1 to 2 fl. dr.

8. Glycerinum Plumbi Subacetatis.—Lead acetate, 5 ; lead oxide, $3\frac{1}{2}$; glycerin, 20 ; water, 12. Boil.

9. Glycerinum Tragacanthæ.—Tragacanth, 1; glycerin, 3; water, 1.

10. Suppositoria Glycerini.—Gelatin, 1; glycerin, 5; water, q. s.; each suppository contains 70 per cent. of glycerin. They must be kept wrapped in waxed paper, as they absorb moisture.

Glycerin is also contained in Linimentum Potassii Iodidi cum Sapone, in Mel Boracis, in all Lamellæ, in Extractum Cinchonæ Liquidum, Pilula Quininæ Sulphatis, Syrupus Pruni Virginianæ, Lotio Hydrargyri Nigra, Liquor Ethyl Nitritis, Liquor Thyroidei, Tinctura Rhei Composita, Tinctura Kino, Unguentum Acidi Carbolici, Unguentum Sulphuris Iodidi, and in Unguentum Iodi.

ACTION.

External.—As glycerin is an excellent solvent for numerous bodies, such as iodine, bromine, alkalies, tannic acid, many neutral salts, alkaloids, salicin, &c., it is a good vehicle for applying these substances to the skin and to sores. It does not evaporate nor turn rancid, and is powerfully hygroscopic.

Internal.—In man the only visible effect produced by its administration is **purging.** This occurs with quite small doses if it is given by the rectum, but large doses are necessary if given by the mouth. It is absorbed from the alimentary canal, and is to a slight extent a food, for some of it is oxidized in the body. Sometimes its administration leads to the appearance in the urine of a body which reduces cupric oxide and gives the fermentation test for sugar. There has been much dispute as to whether glycerin can control nitrogenous metabolism, but it appears that it cannot in any way save the waste of nitrogenous tissues. It probably has some influence on the amount of glycogen in the liver. It has also been thought to prevent artificial glycosuria, but this is doubtful.

Very large doses in animals cause the urine to be dark from the presence of the colouring matter of the blood, although there are no corpuscles in it;

they also lead to loss of muscular strength, lethargy, dryness of mucous membranes, collapse, and death.

THERAPEUTICS.

External.—Glycerin is much employed as a basis for applications to the skin and the eye. It is commonly used for chapped hands and slight excoriations. It is readily absorbed when rubbed into the skin, therefore it is a convenient vehicle for the absorption of substances by the skin. Belladonna mixed with glycerin is often rubbed in when we desire its local anodyne action (*see* p. 338).

Internal.—As glycerin is sweet it is an excellent flavouring agent. It is demulcent, and is used as a vehicle for applying substances, such as tannic acid, to the throat. It is rarely given by the mouth for any medicinal virtue. It has been administered for dyspepsia, for diabetes, and as a nutritive agent, but in each case without any good result. One to two fluid drachms injected up the rectum, or a glycerin suppository, form an excellent means of opening the bowels in simple constipation, especially when the fæces are in the sigmoid flexure and rectum. The result is prompt, often occurring within less than half an hour. No pain nor constitutional disturbance is produced.

OLEIC ACID.

Acidum Oleicum.—$CH_3(CH_2)_7CH{:}CH(CH_2)_7COOH$.

SOURCE.—Made by the saponifying action of alkalies and the subsequent action of acids, or by saponifying oils and fats with superheated steam. The oleic acid is separated from the solid fats present by pressure. In the case of olive oil the reaction is $C_3H_5(C_{18}H_{33}O_2)_3 + 3H_2O = 3HC_{18}H_{33}O_2 + C_3H_5(OH)_3$ (glycerin).

CHARACTERS.—A straw-coloured liquid, nearly odourless and tasteless, very faintly acid. By exposure it darkens in colour and becomes rancid. It becomes semi-solid at 40° F. Sp. gr. 0·89 to 0·91. *Solubility.*—Not in water. Easily in alcohol, chloroform, and ether.

IMPURITIES.—It is rarely pure, usually containing stearic and palmitic acids.

Oleic acid is contained in Unguentum Atropinæ, in Unguentum Aconitinæ, and Unguentum Veratrinæ.

Lead plaster contains oleate of lead and *Zinc oleate ointment contains* oleate of zinc.

Hydrargyri Oleas is official.

ACTION AND THERAPEUTICS.

Oleic acid is used as a solvent for remedies which it is desired to apply by means of cutaneous inunction, for it more readily penetrates the skin than fats and oils.

ALMONDS.

Amygdala Dulcis.—Sweet Almond. *Synonym.*—Jordan almond. The ripe seed of *Prunus amygdalus*, var. *dulcis* (Nat. Ord. *Rosaceæ*).

CHARACTERS.—More than 1 in. long; oblong, acute at one end, rounded at the other, flattened; brown, slightly rough exterior. Taste sweet and nutty.

COMPOSITION.—The chief constituents are—(1) *Oleum Amygdalæ* (*see* p. 540), 50 per cent., the same fixed oil as in bitter almonds. (2) Emulsin and other albuminous bodies.

IMPURITY.—The bitter almond, giving an odour of prussic acid when rubbed with water.

Preparations.

1. Pulvis Amygdalæ Compositus. — Sweet almonds, 8; sugar, 4; gum acacia, 1.

Dose, 60 to 120 gr.

2. Mistura Amygdalæ.—Compound almond powder, 1; water, 8.

Dose, ½ to 1 fl. oz.

Amygdala Amara.—Bitter Almond. The ripe seed of *Prunus amygdalus*, var. *amara* (Nat. Ord. *Rosaceæ*).

CHARACTERS.—Like the sweet almond, but broader and shorter, with a bitter taste.

COMPOSITION.—The chief constituents are—(1) *Oleum Amygdalæ* (*see* p. 540), 50 per cent. (2) *Emulsin.* (3) *Amygdalin*, $C_{20}H_{27}NO_{11}$, a crystalline soluble glucoside which, on distilling with water, is hydrolysed by the enzyme, emulsin, and yields glucose, prussic acid and *Oleum Amygdalæ Amaræ* (*synonym*—Essential oil of bitter almonds) (not official). Thus $C_{20}H_{27}NO_{11} + 2H_2O = C_6H_5COH$ (the essential oil) + HCN +

$2C_6H_{12}O_6$. The oil itself is not poisonous, and is used to flavour sweets; nitro-benzol is often substituted, and has caused death.

Oleum Amygdalæ.

Source.—The fixed oil obtained by expression from either sweet or bitter almonds.

Characters.—Pale yellow, nearly inodorous, with an oleaginous, nutty taste. *Solubility.*—Slightly in alcohol, easily in ether or chloroform. Sp. gr. 0·915 to 0·920.

Almond oil is contained in Linimentum Ammoniæ, Oleum Phosphoratum, Unguentum Cetacei and Unguentum Aquæ Rosæ, as it makes a whiter ointment than olive oil.

Action and Therapeutics.

The sweet almond is demulcent. Its most important medicinal use is that it is made into flour to replace starchy food in cases of diabetes. Biscuits are made of the flour. These are very palatable, are a good nutritive food, and contain very little starch. The only objection to them is their price. With a little care they can be made at home. The flour of other nuts, as Brazil nuts, has been used, but it is not nearly so palatable.

The almond mixture is a very pleasant vehicle for the suspension of insoluble substances, and the powder is a palatable basis for powders.

Oleum Amygdalæ might be used for the same purposes as olive oil. It is pleasanter, but very expensive.

TRAGACANTH.

Tragacantha.—A gummy exudation obtained by incision from *Astragalus gummifer* and other species of Astragalus (Nat. Ord. *Leguminosæ*). Known in commerce as Syrian Tragacanth. From Asia Minor.

Characters.—In white or yellowish, thin, flaky pieces, of varying size or shape, marked with concentric ridges, somewhat translucent, tough, but more pulverisable at a temperature of 120° F. Odourless and almost tasteless. Sparingly soluble in cold water, but swells into a gelatinous mass, which is tinged violet (not so deep as the colour given by starch) by tincture of iodine. *Resembling tragacanth.*—Scilla, which is thicker and opaque.

Impurities.—Other gums.

Composition.—The chief constituents are—(1) *Tragacanthin* (said to be identical with Bassorin), a gum, $C_{12}H_{20}O_{10}$, 33 per cent., only slightly soluble in water, unfermentable. (2) An *Arabin* like gum, 53 per cent., soluble in water, very like the arabin of acacia, but it is precipitated by lead acetate or ferric chloride. (3) A little starch.

Preparations.

1. Glycerinum Tragacanthæ.—Tragacanth, 1; glycerin, 3; water, 1.

2. Mucilago Tragacanthæ.—Tragacanth, 1; alcohol (90 per cent.), 2; water, 80.

Dose, 1 to 4 fl. dr.

3. Pulvis Tragacanthæ Compositus.—Tragacanth, 1; gum acacia, 1; starch, 1; sugar, 3.

Dose, 20 to 60 gr.

Tragacanth is contained in Confectio Sulphuris, Mistura Cretæ, Mistura Guaiaci, Pilula Ferri, Pilula Quininæ Sulphatis, and Pulvis Opii Compositus.

Mucilage of Tragacanth is contained in Lotio Hydrargyri Nigra.

Action and Therapeutics.

Tragacanth is a demulcent, and as such may be soothing when applied to a sore throat. Its chief use is to suspend insoluble bodies, as resins, oils, and insoluble powders. The mucilage is better for this purpose than the compound powder, which, because of its starch, is liable to ferment.

GUM ACACIA.

Acaciæ Gummi.—A gummy exudation from the stem and branches of *Acacia Senegal* (Nat. Ord. *Leguminosæ*), and from other species of *Acacia*. Kordofan.

Characters.—Round or ovoid tears or masses. Colourless, or with a yellowish-brown tint. The tears are either opaque from numerous minute fissures and brittle, or they are glistening, transparent, and difficult to break. No odour.

Taste bland, mucilaginous. *Solubility.*—Freely in water, not in alcohol.

COMPOSITION.—The chief constituent is *arabin*, or *arabic acid*, $C_6H_{10}O_5$; most of it is combined with calcium, but some with magnesium and potassium. It is unaffected by lead acetate.

IMPURITIES.—Starch, gum-resins.

INCOMPATIBLES.—Alcohol, sulphuric acid, borax, per-salts of iron, and lead subacetate.

Preparation.

Mucilago Acaciæ.—Gum acacia, 4; water, 6. **Dose, 1 to 4 fl. dr.**

Gum acacia is contained in Pilula Ferri, Pulvis Amygdalæ Compositus, Pulvis Tragacanthæ Compositus, and all Trochisci.

ACTION AND THERAPEUTICS.

Gum acacia is demulcent. It is used to suspend insoluble substances, as oils, resins, and insoluble powders. A fluid ounce of most oils or resinous tinctures requires 3 fl. dr. of mucilage of acacia for suspension, but copaiba requires 10 fl. dr. A disadvantage of it is that it is liable to undergo acetous fermentation. It may give rise to indigestion and diarrhœa.

LIQUORICE.

Glycyrrhizæ Radix.—Liquorice Root. The peeled root and peeled subterranean stems of *Glycyrrhiza glabra* and other species (Nat. Ord. *Leguminosæ*). Cultivated in Britain.

CHARACTERS.—Long cylindrical pieces; before being peeled dark brown and longitudinally wrinkled, when peeled yellow, fibrous. Fracture fibrous. Faint odour. When fresh, taste sweet and mucilaginous, slightly acid when dried. *Resembling liquorice.*—Pyrethrum and Taraxacum, which are not sweet.

COMPOSITION.—The chief constituents are—(1) *Glycyrrhizin*, a yellow amorphous glucoside, $C_{24}H_{36}O_9$, probably in combination with ammonia. With acids this yields a very bitter substance, glycyrrhetin, and glucose. (2) Asparagin. (3) Grape sugar, resin, starch, gum, malic acid, &c.

Preparations.

1. **Extractum Glycyrrhizæ.**—Aqueous.
Dose, 5 to 20 gr.

2. **Extractum Glycyrrhizæ Liquidum.**—Aqueous with a little alcohol (90 per cent.).
Dose, 30 to 60 m.

3. **Pulvis Glycyrrhizæ Compositus.**—Senna, 2; liquorice root, 2; fennel, 1; sublimed sulphur, 1; sugar, 6.
Dose, 60 to 120 gr.

Liquorice or its preparations are contained in many preparations, generally to cover their nauseous taste. They hide very well that of aloes, cascara sagrada, ammonium chloride, hyoscyamus, senega, senna, turpentine, and bitter sulphates, as quinine sulphate.

ACTION AND THERAPEUTICS.

Liquorice is an excellent demulcent for sore throats. It is used to hide the taste of nasty medicines, and as a basis for pills. The compound liquorice powder is laxative in virtue of its senna and sulphur.

LINSEED.

Linum.—Linseed. The dried ripe seeds of *Linum usitatissimum*, flax (Nat. Ord. *Lineæ*). Cultivated in Britain.

CHARACTERS.—Small, flat, oval, pointed, with acute edges; brown, smooth, shining externally, yellowish white within; odourless; testa mucilaginous.

COMPOSITION.—The covering contains much mucilage. The interior contains a fixed oil (30 per cent. q.v.).

Linum Contusum.—Crushed Linseed. *Synonym.*—Linseed meal. Linseed reduced to powder. It should be recently prepared.

Oleum Lini.—Linseed Oil.

SOURCE.—Expressed at ordinary temperature from Linseed.

CHARACTERS.—It is viscid, yellow fixed oil, of sp. gr. 0·932. It is commonly called 'drying oil' because it unites with oxygen and becomes resinoid on exposure, the linoleic acid in it becoming oxylinoleic acid.

COMPOSITION.—It is a compound of glyceryl with linoleic acid.

ACTION AND THERAPEUTICS.

A linseed poultice (mix gradually 4 parts of crushed linseed with 10 of boiling water, stirring all the while. Do it before the fire, and heat the basin first so that the poultice may be as warm as possible) is a very common means of applying warmth and moisture to a part. It is used to relieve pain, and as a mild irritant to accelerate inflammation and the bursting of an abscess, or as a counter-irritant in all sorts of deep-seated inflammations. The poultices should not be too thick, and should be smeared with oil to prevent their sticking to the skin. A layer of linseed meal may be placed on the powdered ice of an ice poultice (*see* p. 112), to absorb the water and to prevent the lumps of ice from hurting the skin. The ice poultice may be made in between sheets of thin gutta-percha, and the edges stuck together by being moistened with chloroform.

Linseed oil is applied to burns. Mixed with an equal quantity of lime water it forms carron oil, which is a substitute for Linimentum Calcis.

Linseed tea (linseed, 150 gr.; liquorice, 50 gr.; boiling water, 10 fl. oz.; infuse for two hours) is a common domestic demulcent; the large quantity of mucilage it contains forms a coating for the pharynx and mouth, and thus relieves cough due to sore throat. It is said to be slightly diuretic.

SUGAR.

Saccharum Purificatum.—Refined Sugar. *Synonyms.*—Cane sugar, Sucrose. $C_{12}H_{22}O_{11}$.

Preparations.

1. Syrupus.—5 in 2½ of water with the aid of heat. Sp. gr. 1·330.

2. Syrupus Glucosi.—Syrup, 2 oz.; liquid glucose of commerce, 1 oz.

ACTION AND THERAPEUTICS.

Sugar is used as a sweetening agent, and in Liquor Calcis Saccharatus it increases the solubility of the lime. Syrupus Glucosi is used in pharmacy, especially in the making of pills, as it forms a neutral basis.

Malt.—(Not official.)

Synonym.—Byne. The seed of common barley, *Hordeum distichum* (Nat. Ord. *Graminaceæ*), caused to enter the incipient stage of germination by heat and then dried. It contains the ferment diastase, which can convert starch into dextrin and maltose. Thus $10(C_6H_{10}O_5)n + 4nH_2O = 4nC_{12}H_{22}O_{11}$ maltose + $(C_{12}H_{20}O_{10})n$ dextrin.

Extractum Malti.—Extract of Malt. (Not official.) *Synonym.*—Extractum Bynes, Maltine. A liquid of the density of honey.

SOURCE.—It is prepared in many ways from malt, but the basis of them all is that malt is macerated with water at about 125° F. to 160° F., and evaporated to the consistency of a thick extract. Sometimes cold water is added and the mixture is heated to between 125° and 160° F., or the warm water may be added at once. The maceration lasts several hours. Sometimes the extract is then boiled to destroy the diastasic ferment, for then it keeps better, but it loses a valuable constituent. Manufacturers often mix flour with the malt. The evaporation may be conducted *in vacuo*, and in some specimens the maltose has undergone some alcoholic fermentation; any quantity from a trace to 10 per cent. of alcohol may be present.

COMPOSITION.—This varies very much. The chief constituent is *maltose*, $C_{12}H_{22}O_{11}$; there is also some dextrin, $C_{12}H_{22}O_{10}$, some diastase (unless destroyed by boiling), albumens, the salts of barley, and sometimes alcohol.

CHARACTERS.—A sweet, thick, brownish liquid, like honey. Good specimens can by their diastase convert starch into maltose. It forms an emulsion with oils.

ACTION AND THERAPEUTICS.

Maltose is a very valuable food, especially for persons who are suffering from wasting diseases, and have a feeble digestion. It is easily tolerated by the stomach, even when, as is often the case in phthisis, other food, especially cod-liver oil, is rejected. In such a case a malt extract is an excellent substitute for cod-liver oil. Maltose as a food leads to the formation of fat. The diastase contained in malt extract acting upon the starch in farinaceous food converts it into dextrin and maltose, and thus if the secretion of saliva and pancreatic juice is feeble, the maltine to some extent supplies their place. Like the ferments in pancreatic juice and saliva, diastase can only act in an alkaline medium, and therefore extract of malt should not be given till at least two hours after a meal. Emulsions of cod-liver oil in it are frequently useful. Bynol is an example of these. A mixture of extract of malt and iron is also valuable (iron pyrophosphate, 2 parts; water, 3 parts; dissolve and add extract of malt, 95 parts. Mix. Dose, 1 to 4 fl. dr.).

Soya Beans.—(Not official.)

The beans of *Soya hispida.* These are powdered and made into a flour, from which bread and biscuits are prepared. The flour contains very little starch or sugar, sometimes not more than 2 or 4 per cent.

Action and Therapeutics.

Bread and biscuits made from the flour are used in the treatment of diabetes as a substitute for gluten bread; they are quite as efficacious in reducing the sugar passed in the urine, and many patients prefer the taste.

GROUP X.

Vegetable drugs which are used to kill parasites.

Class I. *Anthelmintics* for the various species of *Tape worm.*

Male fern, Pomegranate bark, Cusso.

Class II. *Anthelmintic* for the *Roundworm* (*Ascaris lumbricoides*).

Santonin.

Class III. *Anthelmintics* for the *Threadworm* (*Oxyuris vermicularis*). These are described under the head of astringents (*see* page 523).

Class IV. *Parasiticides* used for pediculi.

Stavesacre, Picrotoxin.

Class I. **Anthelmintics used for Tapeworms.**

MALE FERN.

Filix Mas.—Male Fern. The rhizome of *Aspidium filix-mas* (Nat. Ord. *Filices*), collected late in autumn; divested of its leaves, roots, and all dead portions, and carefully dried. Should not be kept more than one year.

Characters.—3 to 6 or more in. long. The rhizome ¾ to 1 in. in diameter, entirely covered by the curved, angular, dark brown bases of the petioles which bear membranous scales; brown externally, yellowish white or brownish within. Odour feeble, disagreeable. Taste sweetish and astringent at first, subsequently bitter and nauseous.

Composition.—The chief constituents are—(1) *Filicic acid*, a colourless crystalline body, said to be the active principle. (2) A fixed oil. (3) A volatile oil. (4) Tannic and gallic acids. (5) Resins.

Dose, 60 to 180 gr. powdered.

Preparation.

Extractum Filicis Liquidum. *Synonym.*—Oil of male fern. Male fern is percolated with ether, which is then evaporated, and an oily liquid is left, which is really an oleoresin.

Dose, 45 to 90 m. in an emulsion with mucilage of acacia or tragacanth, as water precipitates the resin.

Action and Therapeutics.

Male fern is the most certain **anthelmintic** we have for the common **tapeworm** and the bothriocephalus latus. The pharmacopœial dose is rather small. 1 to 2 fl. dr. of the extract is a usual quantity to give.

It may be flavoured with ginger or peppermint. The intestine should first be emptied with a little castor oil to ensure the worm not being protected by food. Then the male fern should be administered, and about twelve hours afterwards another dose of castor oil should be given to clear away the dead worm. Very little food should be taken during the treatment, and the head of the worm should be carefully searched for in the motion.

The extract also kills the *Anchylostoma duodenale* outside the body, and has been successfully given to persons suffering from this parasite.

POMEGRANATE BARK.

Granati Cortex.—Pomegranate Bark. The dried bark of the stem and root of *Punica granatum* (Nat. Ord. *Myrtaceæ*). South of Europe.

CHARACTERS.—Curved or channelled pieces, 2 to 4 in. long, ½ to 1 in. wide. Outer surface of root rough and yellowish grey with irregular depressions, that of stem smoother. Internally yellow, nearly smooth. Fracture short. Odourless. Taste astringent.

COMPOSITION.—The chief constituents are—(1) *Pelletierine*, ½ per cent., a colourless crystalline alkaloid. (2) Punico-tannic acid, 22 per cent. (3) Isopelletierine and other alkaloids.

INCOMPATIBLES.—Alkalies, lime water, metallic salts, gelatine.

Preparation.

Decoctum Granati Radicis.—1 in 5.
Dose, ½ to 2 fl. oz.

ACTION AND THERAPEUTICS.

The bark of the pomegranate is a powerful **astringent**, and the decoction may be used as a gargle for a sore throat. In large doses it is emetic and purgative. It is believed to be **anthelmintic** for the tapeworm. It is usually said that the pelletierine is the active anthelmintic principle; but according to some the tapeworm is not killed, but is expelled by the purgative with which a dose of the decoction is usually followed. Sulphate of pelletierine —a thick, oily liquid, dose 3–8 minims—and the tannate, a solid, dose 3–8 grains—are both said to be very efficient for killing the common tapeworm.

CUSSO.

Cusso. *Synonym.*—Kousso. The dried panicles of pistillate flowers of *Brayera Anthelmintica* (Nat. Ord. *Rosaceæ*). Abyssinia.

Characters.—In compact clusters or rolls, 1 to 2 ft. long. Odour tea-like. Taste bitter. Separate panicles, branched, zigzag, with hairs and glands on them, and a large bract at the base of each branch. Flowers numerous, small, shortly stalked, unisexual, male brownish, female reddish. Two bracts at the base of each flower. Calyx hairy, veiny; ten segments on two alternating whorls.

Composition.—The chief constituents are—(1) Koussin, a neutral active principle soluble in alkalies. (2) Oil, gum, tannic acid and resin.

Dose, ¼ to ½ oz.

Action and Therapeutics.

Cusso is rarely given in England, but is used abroad as an **anthelmintic** for all species of tapeworm. It is best given as an infusion, which is drunk without straining.

Class II. Anthelmintic used for Roundworm.

SANTONIN.

Santoninum.—Santonin, $C_{15}H_{18}O_3$. A neutral crystalline principle obtained from santonica, the dried unexpanded flower heads or capitula of *Artemisia maritima*, var. *Stechmanniana* (Nat. Ord. *Compositæ*).

Characters.—Colourless, flat, glittering, rhombic prisms, turning yellow on exposure to light. Tasteless or feebly bitter *Solubility.*—Not at all in mineral acids, feebly in cold water, easily in chloroform. It forms santonates with alkalies.

Dose, 2 to 5 gr.

Preparation.

Trochiscus Santonini.—1 gr. in each with a simple basis.

ACTION.

Santonin is **anthelmintic, killing the roundworm,** *Ascaris lumbricoides*, and, according to some authorities, the *Oxyuris vermicularis*, but this is doubtful, for it does not kill these worms outside the body, and therefore if efficient must be changed in the intestine. It has no action on tapeworms. Some of the santonin is absorbed as sodium santonate. Medicinal doses will usually cause the urine, if it is acid, to be a greenish-yellow or saffron colour, and if it is alkaline to be purplish red. This is due to the excretion in that fluid of some substance resulting from the changes undergone by santonin in the body. It is slightly diuretic. Often even small doses lead to xanthopsy—that is to say, everything the patient sees has a yellow tint; this is not the result of the staining of the tissues of the eye yellow, but is a direct effect on some other part of the visual path.

Several cases of fatal poisoning by santonin are on record. Cerebral symptoms are very prominent. Thus convulsions, accompanied by unconsciousness, trismus, and dilated pupils are generally present. The surface becomes cold, there is sweating, there may be trembling, the pulse and respiration become weaker and weaker, and death takes place from cardiac and respiratory failure.

THERAPEUTICS.

Santonin is used solely to kill intestinal worms. The dose of it should be given on an empty stomach, and should be followed in two hours by a purgative, such as calomel, which acts on the small intestine, for this is the part inhabited by the worms killed by santonin. It is certainly very efficacious for the *Ascaris lumbricoides*. The lozenge is not to be recommended, for it may not dissolve, and then will probably fail to kill the worm. A good way to give santonin is to suspend it and castor oil in mucilage flavoured with peppermint. As already mentioned, probably it has no effect on the *Oxyuris vermicularis* when given by the mouth, but a suppository made with oil of theobroma, and containing 4 grains of santonin, is said to kill this parasite.

Class IV. **Parasiticides used for Pediculi.**

STAVESACRE.

Staphisagriæ Semina.—Stavesacre Seeds. The dried ripe seeds of *Delphinium staphisagria* (Nat. Ord. *Ranunculaceæ*).

CHARACTERS.—Irregularly triangular or obscurely quadrangular, arched, blackish brown when fresh, but becoming dull greyish brown by keeping. Testa wrinkled and deeply pitted, nucleus soft, whitish and oily. No marked odour. Taste nauseous, bitter and acrid.

COMPOSITION.—The chief constituents are—(1) A fixed oil. (2) A very poisonous alkaloid, *delphine*, acting like aconitine. (3) Other alkaloids.

Preparation.

Unguentum Staphisagriæ.—Crushed seeds, 2; yellow beeswax, 1; benzoated lard, 8½.

ACTION AND THERAPEUTICS.

Stavesacre is only used as a **parasiticide** to kill pediculi. The affected part is rubbed with the ointment, which in the case of pediculi vestimentorum is allowed to soak, day and night, into the garments next to the skin, for the parasite inhabits them. It is often employed, but it will be remembered that many other parasiticides for pediculi have been mentioned (*see* p. 40).

PICROTOXIN.

Picrotoxinum.—Picrotoxin. A neutral principle obtained from the fruits of *Anamirta paniculata*, Indian berry or fish-berry, the fruit of which is known as *Cocculus indicus* (Nat. Ord. *Menispermaceæ*). India.

CHARACTERS.—Colourless shining prisms with an intensely bitter taste. *Solubility.*—1 in 330 of cold, 1 in 55 of boiling, water. Freely in ether, not in oil. It does not form salts. Probably commercial picrotoxin is a mixture of several bodies.

Dose, $\frac{1}{100}$ to $\frac{1}{25}$ gr. in a pill.

ACTION.

External.—Picrotoxin is very destructive to lower forms of life, and is therefore **antiparasitic.**

Internal.—It is a powerful poison, causing convulsions, hyperpyrexia, and stimulation of the respiratory centre. Its mode of action is unknown.

THERAPEUTICS.

External.—An ointment of 80 gr. of the seeds to 1 oz. of lard has been applied to the scalp to kill pediculi. It must be employed with caution, for this strong poison can be absorbed if the skin be broken. It is an expensive ointment.

Internal.—Picrotoxin is used empirically to **check** the night **sweating** of phthisis. A single dose should be given in the evening. Its action is uncertain, but sometimes it succeeds. Epilepsy and many other diseases have been treated with it, but there is no evidence that it has benefited them. Lamellæ, each containing $\frac{1}{100}$ of a grain, are prepared for subcutaneous injection. One should be dissolved in a few minims of water immediately before use.

GROUP XI.

Vegetable drugs apparently having only a diuretic action.

Uva Ursi, Scoparium, Triticum.

UVA URSI.

Uvæ Ursi Folia. *Synonyms.*—Bearberry leaves. The dried leaves of *Arctostaphylos uva-ursi* (Nat. Ord. *Ericaceæ*). Britain.

Characters.—Very shortly stalked, yellowish green, obovate or spathulate, coriaceous, ½ to ¾ in. long. Upper surface smooth and shining; under paler, minutely reticulated. Taste very astringent. *Resembling Uva Ursi.*—Senna (*see* p. 435) and buchu (*see* p. 506).

Composition.—The chief constituents are—(1) *Arbutin*, $C_{24}H_{32}O_{14}$, a bitter crystalline glucoside yielding glucose, hydroquinone, and methyl-hydroquinone. (2) Ericolin, a bitter crystalline glucoside. (3) Urson, a tasteless neutral body. (4) Tannic and gallic acids, 33 per cent.

Incompatibles.—Iron, lead and silver salts, alkaloids, and gelatin.

Preparation.

Infusum Uvæ Ursi.—1 in 20 of boiling water. **Dose, ½ to 1 fl. oz.**

Action.

Uva Ursi is a well-marked **diuretic**, and is **astringent** and **disinfectant** to the **urinary mucous membrane**. Its disinfectant action is probably due to the decomposition of the arbutin into glucose and hydroquinone, for after Uva Ursi is given hydroquinone is found in the urine, and it is a very energetic antiseptic. This decomposition must take place in the kidneys, for hydroquinone is a powerful poison. Against this being the reason of the disinfectant action of Uva Ursi, it is urged that giving arbutin does not disinfect the urine; but others deny this, and the probability is that the first-mentioned view is correct. Arbutin itself is a powerful diuretic. The urine may be a pale greenish to dark greenish-brown colour. Hydroquinone is also found in the urine in carbolic acid poisoning (*see* p. 295). The astringent action of Uva Ursi on the urinary tract is usually ascribed to the gallic and tannic acids, but as these are not remote astringents this is most likely wrong.

THERAPEUTICS.

Uva Ursi is given to disinfect the urine in the same class of cases as buchu—that is to say, in pyelitis, cystitis, and gonorrhœa.

BROOM.

Scoparii Cacumina.—Broom Tops. The fresh and dried tops of *Cytisus scoparius* (Nat. Ord. *Leguminosæ*). Indigenous.

CHARACTERS.—The stem is dark green, with long, straight, alternate branches. The latter, like the stem, are winged, tough and flexible. Occasionally with leaves attached. These are small, sessile and simple above, stalked and trifoliate below. Taste bitter and nauseous. When bruised gives a peculiar odour if fresh.

COMPOSITION.—The chief constituents are—(1) *Scoparin*, $C_{21}H_{22}O_{10}$, a yellow, crystalline, neutral principle, which is diuretic. (2) *Sparteine*, $C_{15}H_{26}N_2$, an oily, liquid, volatile alkaloid; it also is said to be diuretic.

Preparations.

1. **Infusum Scoparii.**—*Dried* broom tops, 2; boiling water, 20.
Dose, 1 to 2 fl. oz.

2. **Succus Scoparii.**—Juice of the *fresh* broom tops, 3; alcohol (90 per cent.), 1.
Dose, 1 to 2 fl. dr.

ACTION.

Broom has no external action, and very little beyond the fact that it is **diuretic** is known about its internal action. Sparteine increases the force of the heart like digitalis, but it is not nearly so certain in its action. Both it and scoparin are said to be the diuretic principles of broom.

THERAPEUTICS.

Broom is a very useful diuretic. It is usually given in combination with other diuretics in cases of dropsy from heart disease or interstitial nephritis. If there is acute renal inflammation it should not be prescribed. Sparteine has been tried (best given as the sulphate, dose 1–4 gr.) in mitral disease, but it is certainly not so valuable as digitalis.

Triticum.—(Not official.)
The underground stems of *Triticum repens*, couch-grass, or dog-grass.

Preparation (Brit. Pharm. Conference).

Extractum Tritici Liquidum.
Dose, 1 to 6 fl. dr.

ACTION AND THERAPEUTICS.

It is diuretic, and is used as a sedative in inflammation of the genito-urinary mucous membrane.

GROUP XII.

Vegetable drugs acting locally on unstriped muscle, especially that of the uterus.

This group contains only **Ergot.**

ERGOT.

Ergota.—Ergot. The sclerotium (compact mycelium or spawn) of *Claviceps purpurea* (Nat. Ord. *Fungi*), originating in the ovary of *Secale cereale*, the common rye (Nat. Ord. *Graminaceæ*). Spain and Russia.

Ergot is no part of the rye grain, which completely disappears as the ergot develops.

CHARACTERS.—Subcylindrical, tapering at both ends, curved, $\frac{1}{3}$ to $1\frac{1}{2}$ in. long. Longitudinally furrowed on both sides, especially the concave, often cracked. Dark violet-purple without, pinkish white within. Fracture short. Odour peculiar, disagreeable. Taste mawkish, rancid.

COMPOSITION.—The chief constituents are—(1) *Sphacelinic acid*, a non-nitrogenous unstable body insoluble in water, soluble in alcohol. Its alkaline salts are soluble in water, but readily decomposed. It produces tonic contractions of the uterus and contracts the blood-vessels. (2) *Cornutine*, an alkaloid insoluble in water. It produces rythmic contractions of the uterus exactly like those which occur naturally. The so-called sclerotinic acid which can be extracted from ergot is really a mixture of sphacelinic acid and cornutine. (3) *Ergotinic acid*, a glucoside. (4) Ergotinine. (5) A fixed oil, 30 per cent. (6) Trimethylamine, to which the odour is due. (7) Tannin. Many other bodies are said to have been found in ergot, but those given are believed to be the more important; the composition of ergot is not yet certainly made out.

Dose, 20 to 60 gr.

Preparations.

1. **Extractum Ergotæ.**—*Synonym.*—Ergotin. Percolate powdered ergot with alcohol (60 per cent.), evaporate the percolate and add to it distilled water. Filter and add dilute hydrochloric acid to the filtrate, wash this with water until not acid, and then add sodium carbonate and evaporate to a soft extract.

Dose, 2 to 8 gr.

2. **Injectio Ergotæ Hypodermica.**—Extract of ergot, 100 gr.; distilled water, 220 ♏; carbolic acid, 3 gr., to preserve it. *Strength.*—33 per cent. of the extract.

Dose, 3 to 10 m. hypodermically. It should be recently prepared.

3. **Extractum Ergotæ Liquidum.**—Ergot is extracted with equal parts of water and alcohol (90 per cent.).

Dose, 10 to 30 m.

4. **Infusum Ergotæ.**—1 in 20 of boiling water.

Dose, 1 to 2 fl. oz.

5. **Tinctura Ergotæ Ammoniata.** — Ergot, powdered, 5; solution of ammonia, 2; alcohol (60 per cent.), to make 1 pint. Percolate.

Dose, 10 to 60 m.

This tincture is ammoniated, as ammonia is said to be the best solvent for the active principles of ergot.

Discs or lamellæ (not official) of ergotin are prepared for subcutaneous injection. They should be dissolved in a few minims of warm water immediately before use.

As the solubility and stability of the constituents vary, many believe it is best to give the powdered drug, using specimens not more than a year old.

ACTION.

External.—None.

Internal. — *Gastro-intestinal tract.* — The unstriped muscle of the intestine is stimulated by ergot, and this leads to greatly increased peristaltic movements, sometimes strong enough to cause relaxation of the bowels. The vessels of the intestine are constricted, in part because of the contraction of their own muscular fibres, and in part because of the contraction of those of the intestinal muscular coat. The result is that the intestine is blanched.

Blood.—The active principles of ergot are readily absorbed, but they are not known to produce any effect on the blood.

Heart.—The activity of the heart muscle is depressed by ergot; therefore the rate of the pulse falls, and consequently at first the blood-pressure falls.

Vessels.—But the fall of blood-pressure is soon followed by a great rise, and this is due to the **general contraction** of the **arteries** all over the body; they can, in some parts, be seen to become smaller. The veins are contracted to a less extent. This vascular contraction does not take place if the spinal cord is destroyed, from which it is fair to infer that it is due to the action of ergot on the vaso-motor centres in the cord. Because it contracts the arterioles it is **hæmostatic.** If the ergot be taken for a long time, the contraction of the arteries leads to **gangrene** of various parts of the body, and this was a prominent symptom of ergotism (chronic poisoning by ergot) which used to be seen in the very poor who could get no better food than rye infested with *Claviceps purpurea.* Enormous single doses of ergot appear to paralyse the vaso-motor centres, and then the blood-pressure falls from vascular dilatation and cardiac depression.

Nervous System.—Medicinal doses, or even an enormous single dose, very rarely affect the nervous system, but if ergot be taken for a long time, a peculiar train of symptoms sets in; they constituted the second variety of chronic ergotism in the days when diseased bread was eaten. The sufferer first complained of itching and tingling, and a sensation of insects running over the skin; this was followed by **numbness and local anæsthesia.** These symptoms first appeared in the hands and feet, but spread over the whole body. They were followed by **tonic contractions** of various muscles, especially those of the extremities. The muscular power was lessened, and the gait was staggering. Later on there was **diminution of sensation. Dimness of vision** and loss of hearing were sometimes present. This variety of ergotism was usually accompanied by vomiting and diarrhœa. Death occurred from asphyxia, due to spasm and weakness of the respiratory muscles.

Uterus.—Ergot powerfully excites the pregnant uterus of women and the lower animals to contract and expel its contents. It is therefore called an **ecbolic.** It is not decided whether this effect is due to the action of the drug on the organ itself or on the spinal centres. Ergot has very little power to cause contraction of the unimpregnated uterus.

The flow of urine, of saliva, of sweat, and of milk is diminished by ergot, probably because of the general vascular constriction.

THERAPEUTICS.

The chief use of ergot is to cause efficient contraction of the uterus after labour, and so to diminish the risk of post-partum hæmorrhage. If there is any likelihood of profuse bleeding it should be given subcutaneously, so that it may act rapidly.

Ergot should be administered cautiously before the child is expelled, for the contractions produced by it not only gradually become more severe, but more prolonged, so that ultimately the uterus remains tightly contracted for several minutes; this is, of course, dangerous to the life of the child, and if the resistance be very great, may lead to rupture of the uterus.

This drug has often been given as a hæmostatic in hæmoptysis and other hæmorrhages from different parts of the body. Some authors claim great success. Frequently it fails, and unless it quite closes the bleeding vessel it is likely that it may, by the general rise of blood-pressure, do more harm than good. It is difficult to gauge its value, for so many hæmorrhages will stop even if no drugs are given.

It has been used to check the night sweats of phthisis, and as an antigalactogogue.

It is often desirable to combine the liquid extract of ergot with perchloride of iron. Because of the tannin in the ergot an inky mixture results, but this may be clarified by the addition of a little dilute phosphoric acid, and the taste may be covered with chloroform water.

GROUP XIII.

Colchicum.

The sole value of this drug is that it is a specific for gout.

COLCHICUM.

Colchici Cormus.—Colchicum Corm. The fresh corm of *Colchicum autumnale* (Nat. Ord. *Liliaceæ*), collected in the early summer; and the same stripped of its coats, sliced transversely, and dried at a temperature not exceeding 150° F. Britain.

Characters.—Fresh corm 1½ in. long, 1 in. broad, conical, flattened on one side, rounded on the other; outer coat thin, brown, membranous, inner coat reddish yellow. Internally white, solid, yielding milky juice of bitter taste and disagreeable odour. Dried slices $\frac{1}{10}$ to $\frac{1}{8}$ in. thick, yellowish at circumference, indented one side, convex the other, and thus reniform in outline. Surfaces firm, whitish, amylaceous. Fracture short. Odour none. Taste bitter.

Composition.—The chief constituents are—(1) *Colchicine*, the active alkaloid, yellowish, micro-crystalline, soluble in water and alcohol, but changed by most acids into colchiceine. (2) Veratrine (*see* p. 398), in traces combined with gallic acid. (3) A fixed oil. (4) Starch, sugar, gum.

Incompatibles.—All astringent preparations, tincture of iodine, and tincture of guaiacum.

Dose, 2 to 5 gr. in powder in cachets.

Preparations.

1. Extractum Colchici.—Made from the *fresh* corm.

Dose, ¼ to 1 gr.

2. Vinum Colchici.—*Dried* corm, 1; sherry, 5.

Dose, 10 to 30 m.

Colchici Semina.—The dried ripe seeds of *Colchicum autumnale.*

Characters.—$\frac{1}{10}$ in. in diameter, subglobular, pointed at hilum, reddish brown, rough, very hard and difficult to powder. Odour none. Taste bitter, acrid. *Resembling colchicum seeds.*—Black mustard seeds (*see* p. 466).

Composition.—The chief constituents are—(1) The same as of the corm, but the proportion of the active alkaloid colchicine is larger. (2) A volatile oil in addition.

Preparation.

Tinctura Colchici Seminum.—Colchicum seeds, 1; alcohol (45 per cent.), 5. Percolate.

Dose, 5 to 15 m.

Made with one and a half times as much seed as in B. P. 1885.

ACTION.

External.—When applied to the skin colchicum acts as an irritant, causing hyperæmia and smarting, and the dust inhaled gives rise to sneezing.

Internal.—*Gastro-intestinal tract.*—In moderate medicinal doses colchicum produces no effect on most persons beyond slightly increasing the secretion of bile, but with others it causes loss of appetite, and a little **purging, nausea,** and **colic.** In larger doses it gives rise, in all persons, to great abdominal pain, vomiting, and profuse diarrhœa with the passage of blood. It is in fact a powerful **gastro-intestinal irritant.** There is also great prostration, the pulse becomes small, rapid, and thready, the skin cold and bedewed with sweat, and the respiration slow; death is due to collapse. It is extremely probable that these results are not owing to any action of colchicine on the heart or respiration, but that they are merely the consequence of the severe gastro-enteritis, which, it is well known, will cause fatal collapse. These effects are produced if colchicine is injected subcutaneously, a circumstance which shows that this alkaloid is an active principle of colchicum, and that it is excreted into the intestine. It is a curious fact that after a certain point increasing the quantity does not lead to an increase of the symptoms.

Nervous system.—Medicinal doses have no effect. Even a fatal dose does not impair consciousness. In frogs the reflex excitability of the cord is at first increased by large doses, and hence there may be convulsions. In mammals these do not take place, but in all animals ultimately the spinal motor centres are powerfully depressed, and the creature is paralysed. Motor nerves and muscles are unaffected. Sensory nerves are somewhat depressed.

Kidneys.—The most discordant statements have been made about the action of colchicum on the urine, but it has not been definitely shown that either the quantity or composition is altered. After death by poisoning, the alkaloid is found in the blood and in most of the organs of the body.

THERAPEUTICS.

Colchicum is hardly ever used except for **gout.** Given during the attack, it most markedly relieves the pain ; in smaller doses given between the attacks it diminishes their severity. It is often very useful for dyspepsia, eczema, headache, neuritis, conjunctivitis, bronchitis, and other conditions which, when occurring in those suffering from gout, are probably related to it. It is a true specific ; how it acts is not known. Occasionally it is combined with other cholagogues, especially if it is desired to give these remedies to a person who is the subject of gout. If any symptoms of gastric or intestinal irritation appear, its use must be discontinued for a time. The seeds are said to be more active than the corm.

GROUP XIV.

The three bodies in this group are white solids, all very closely related to volatile oils, all are antiseptic (two very powerfully so), and two at least, and probably all three, are local anæsthetics.

Camphor, Thymol, Menthol.

CAMPHOR.

Camphora.—$C_{10}H_{16}O$. A white crystalline substance obtained from *Cinnamomum camphora*, the camphor laurel (Nat. Ord. *Laurineæ*), and purified by sublimation. East Indies, China and Japan.

SOURCE.—The wood of the tree is submitted to distillation with steam, and the distilled product on cooling deposits crystals of camphor, which are purified by pressure and sublimation.

CHARACTERS.—Solid, colourless, translucent, crystalline masses ; also in rectangular tablets or pulverulent masses known as 'flowers of camphor.' Tough, but readily powdered if mixed with alcohol, ether, or chloroform. Odour powerful, characteristic. Taste pungent, bitter, followed by a sensation of cold. Floats on water. Sp. gr. 0·99. Burns readily with a bright smoky flame. Volatilizes slowly at ordinary temperatures. Sublimes entirely when heated. *Solubility.*—1 in 700 of water, 1 in 2 of oil of turpentine, 1 in 4 of olive oil, readily in milk, ether, alcohol, or chloroform. When triturated with either chloral hydrate, carbolic acid, or thymol it forms a thick liquid.

Composition.—Camphor, $C_{10}H_{16}O$, is an oxidation produce of pinene (*see* Oil of Turpentine), and may also be derived from cymene found in caraway and eucalyptus oils (q.v.). The pharmacopœial camphor is called laurel camphor; it is dextro-rotatory. Lævo-rotatory and inactive camphors are known. Borneol, $C_{10}H_{18}O$ —known also as Borneo camphor—is often in commerce substituted for official camphor, which it closely resembles, it is derived from *Dryobalanops aromatica*, and is known from the official camphor by sinking in water; it is an alcohol. The common form of Borneol is dextro-rotatory, but lævo-rotatory and inactive varieties are known.

Dose, 2 to 5 gr.

Preparations.

1. **Aqua Camphoræ.**—Dissolve 70 gr. in ½ fl. oz. of alcohol (90 per cent.), and add to a gallon of water. Contains about ½ gr. to 1 fl. oz.

Dose, 1 to 2 fl. oz.

2. **Linimentum Camphoræ.**—*Synonym.*—Camphorated Oil.—Camphor, in flowers, 1; olive oil, 4.

3. **Linimentum Camphoræ Ammoniatum.**—*Synonym.*—Compound Liniment of Camphor. Camphor, 20; strong solution of ammonia, 40; oil of lavender, 1; alcohol (90 per cent.), 120.

4. **Spiritus Camphoræ.**—Camphor, 1; alcohol (90 per cent.), 9.

Dose, 5 to 20 m. In milk or on sugar, as water precipitates the camphor.

5. **Tinctura Camphoræ Composita**, *see* Opium, p. 312.

Camphor is contained in the following liniments: Aconiti, Belladonnæ, Chloroformi, Hydrargyri, Opii, Saponis, Sinapis, Terebinthinæ, and Terebinthinæ Aceticum; and in Unguentum Hydrargyri Compositum.

ACTION.

External.—Camphor, although not a volatile oil, acts very much like one. Thus it is a direct cutaneous stimulant, dilating the vessels of the skin, and at first causing a sensation of **warmth**, but subsequently a slight degree of local **anæsthesia**. It is a feeble antiseptic.

Internal.—*Gastro-intestinal tract.*—In the stomach it is mildly **stimulant**, dilating the vessels, increasing the flow of gastric juice and the peristalsis. Hence it is stomachic and carminative. It has a slight reflex stimulating effect on the heart. In medicinal doses it has little action on the intestines.

Circulation.—It quickly enters the blood both from the skin and the intestine, and is said to increase the number of leucocytes in that fluid. To a slight extent the heart is excited directly by it in addition to the reflex stimulation just mentioned.

Respiration.—Probably some camphor is excreted by the bronchial mucous membrane, the vascularity and secretion of which it consequently stimulates. It has the reputation of being a feeble expectorant.

Skin.—It is a mild **diaphoretic**. This effect is believed to be due to the action of the drug on the central nervous system. Probably some of the camphor is excreted by the skin, for the sweat may smell of it.

Nervous system.—Different people are differently susceptible to the effects of camphor. Five to ten grains will in some persons produce a feeling of exhilaration, or in others a sense of comfort and quietness. Larger doses cause great excitement, giddiness, a slow pulse, and ultimately headache, burning pains in the stomach, faintness, confusion of ideas, delirium, violent convulsions, insensibility, a small feeble pulse, and finally death from collapse. It is a mild antipyretic.

Sexual organs.—Camphor is reputed to be an aphrodisiac, but this is probably incorrect.

Kidneys.—It is not excreted as camphor, but as complex substances, one of which is campho-glycuric acid.

THERAPEUTICS.

External.—Its stimulating effects make camphor a favourite ingredient of many liniments. It is constantly rubbed into the skin in some form or another as a mild irritant or counter-irritant in, for example, chronic rheumatism, chronic inflammatory indurations, and the slighter chest complaints of children; and also in myalgia, neuralgia, lumbago, and sciatica, in which cases, because of its property of causing local anæsthesia, it relieves pain. In addition to the pharmacopœial preparations, a Chloroformum Camphoræ (camphor, 2 parts, dissolved in chloroform, 1 part) may be used. The liquid preparations with chloral, carbolic acid, and thymol are excellent local anodynes for neuralgia, and may be dropped into a tooth to relieve toothache.

Internal.—Camphor is used as a carminative, especially in neurotic subjects. It is a common remedy for a cold in the head, and is probably beneficial on account of its stimulation of the circulation and its slight antipyretic and diaphoretic effects. Many expectorant mixtures contain camphor. It has been given as an antispasmodic in hysteria and allied conditions, and some state that it is of use in cholera.

THYMOL.

Thymol.—Symbol, $C_6H_3{\cdot}OH{\cdot}CH_3{\cdot}C_3H_7$. A crystalline substance obtained from the volatile oils of *Thymus vulgaris* (Nat. Ord. *Labiatæ*), Britain; and *Carum copticum* (Nat. Ord. *Umbelliferæ*), Asia. Purified by recrystallization from alcohol.

Source.—It is a phenol, and can be extracted with caustic soda from oil of thyme, where it is associated with cymene.

Characters.—Large, oblique, prismatic crystals. They sink in cold water. On heating the water they melt and the thymol rises to the surface. Odour of thyme. Taste pungent, aromatic. *Solubility.*—1 in 1500 of cold water, 1 in 190 of glycerin, 1 in 2 of olive oil. Freely in alcohol, ether, or chloroform.

Dose, ½ to 2 gr. as a pill.

Action and Therapeutics.

Thymol is a more powerful **antiseptic** than carbolic acid. It has been used in antiseptic surgery for dressing wounds. A saturated solution of thymol gauze, and thymol ointment are employed. It is non-irritating. It has considerable antiparasitic powers, and solutions in alcohol or ether (1 in 15) have been used in ringworm. A solution in glycerin (1 in 200) has been recommended for sore throats. A little alcohol is very useful for facilitating the aqueous solution of thymol.

Thymol in large doses has been given as an anthelmintic for Anchylostoma duodenale.

MENTHOL.

Menthol. — Symbol, $C_6H_9OH{\cdot}CH_3{\cdot}C_3H_7$. A crystalline substance obtained by cooling the oil distilled from the fresh herb of *Mentha piperita* (Britain) and *Mentha arvensis*, vars. *piperascens et glabrata* (Nat. Ord. *Labiatæ*) (Japan). It is sometimes called mint camphor.

Characters.—In fused crystalline masses or as colourless acicular crystals, moist from adhering oil. Odour as of peppermint. Taste of peppermint; the subsequent coldness on inhalation of air is well marked. Its melting-point should not exceed 110° F. *Solubility.*—Very sparingly in water or glycerin, 5 in 1 of alcohol (90 per cent.), 4 in 1 of chloroform, 1 in 4 of olive oil.

Impurities.—Glass and magnesium sulphate.

Dose, ½ to 2 gr.

Preparation.

Emplastrum Menthol.—Menthol, 1½; yellow beeswax; 1; resin, 7½.

ACTION AND THERAPEUTICS.

Menthol is chiefly employed externally, for it produces local anæsthesia, a feeling of coldness and numbness, and thereby alleviates the pain of neuralgia, especially if it involves a superficial nerve. It is very efficacious in some cases. The solid menthol may be drawn along the skin, or a spirituous solution may be painted on, or the plaster may be applied. If this is used it should be spread on thin rubber cloth or hat lining, as it soaks through calico and linen. In very hot weather the pharmacopœial plaster may be too fluid, and then more wax should be added. A solution of 100 gr. heated in a test-tube containing half an ounce of oleic acid is an excellent preparation, and a very good liniment is formed of menthol, 3 pts.; chloroform, 4 pts.; olive oil, 9 pts. The local application of menthol often relieves itching. Menthol has been applied locally to carious teeth, and has been inhaled with advantage in asthma. It is readily volatilised by the addition of hot water. Solutions of it have been painted on the throat in diphtheria. Its internal administration has been abandoned as useless. It is a powerful antiseptic. Menthol should be preserved in closed tin boxes.

GROUP XV.

Vegetable drugs acting in virtue of important acids they contain.

Lemon juice (citric acid), **Benzoin** (benzoic acid), **Laurocerasi Folia** (hydrocyanic acid), **Chrysarobinum** (chrysophanic acid). *Virginian prune* (*see* p. 409) and *Bitter almond* (*see* p. 539), both of which yield hydrocyanic acid, have already been considered.

LEMON.

Limonis Cortex.—Lemon Peel. The fresh outer part of the pericarp of the fruit of *Citrus medica, var. β Limonum* (Nat. Ord. *Rutaceæ*). South Europe.

Characters.—Thin, pale yellow pieces, rough on the outer surface from the presence of glands containing the oil; inner surface has a little of the inner white rind attached. Fragrant odour; bitter aromatic taste.

Composition.—The chief constituents are—(1) The official *Oleum Limonis* (see below). (2) A bitter principle, hesperidin.

Preparations.

1. **Syrupus Limonis**, *see* p. 569.

2. **Tinctura Limonis.**—Lemon peel, 1; alcohol (90 per cent.), 4. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Lemon peel is contained in Infusum Aurantii Compositum and Infusum Gentianæ Compositum.

In India and the Colonies where fresh lemon peel cannot be obtained, the dried peel may be used for any preparations containing lemon peel.

Oleum Limonis.—The oil obtained from fresh lemon peel.

Source.—Obtained by expression.

Characters.—It is pale yellow, fragrant, warm, and bitter. Sp. gr. 0·857 to 0·860.

Composition.—Oil of lemon contains—(1) A terpene called citrene or limonene, $C_{10}H_{16}$, strongly dextro-rotatory. This is also found in orange peel. (2) Geranial or citral, the aldehyde derived from geraniol found in oil of rose (p. 493).

Dose, $\frac{1}{2}$ to 3 m.

Oil of lemon is contained in Linimentum Potassii Iodidi cum Sapone, Tinctura Valerianæ Ammoniata, Tinctura Guiaci Ammoniata, and Spiritus Ammoniæ Aromaticus.

Action and Therapeutics.

The same as those of orange. The oil applied externally is rubefacient.

Succus Limonis.—Lemon Juice. The freshly expressed juice of the ripe fruit of *Citrus medica, var. β Limonum.*

Characters.—A pale yellow, slightly turbid liquid. Taste acid. Odour of lemons. One fluid ounce contains about 35 gr. of citric acid, and therefore neutralizes 50 gr. of potassium bicarbonate, 42 of sodium bicarbonate, or 24 of ammonium carbonate. It decomposes on keeping, but may be preserved by the addition of 10 per cent. of alcohol.

Composition.—Lemon juice contains citric acid (*see*

p. 238), both free and combined to form potassium and other salts. Also malic acid, $H_3C_4H_3O_5$, and phosphoric acid.

Dose, ½ to 4 fl. oz.

Preparations.

1. **Syrupus Limonis.**—Fresh lemon peel is digested in alcohol. Sugar is dissolved in lemon juice and the two liquids are mixed.

   Dose, ½ to 2 fl. dr.

2. **Acidum Citricum,** *see* p. 238.

ACTION AND THERAPEUTICS.

Lemon juice is used to relieve thirst, and to make effervescing mixtures and drinks. Its action in the body is the same as that of citric acid (*see* p. 238). Three or four ounces of lemon juice daily is of great benefit in scurvy. Why this is so we do not know for certain. Lemon juice is probably more efficacious than citric acid.

BENZOIN.

Benzoinum.—Benzoin. *Synonym.*—Gum Benjamin. A balsamic resin obtained from *Styrax benzoin* and probably other species of *Styrax* (Nat. Ord. *Styraceæ*). Known as Siam and Sumatra benzoin.

CHARACTERS.—Separate tears or masses of tears loosely agglutinated, but generally closely compacted by a deep brown translucent substance. Tears flat or curved, yellowish or reddish brown; they vary in size up to an inch or two; on breaking they either show an opaque milk-white or a reddish-brown appearance. Benzoin is very brittle, and easily softens by the heat of the mouth. Little taste. Odour balsamic. Gives off on heating, fumes of benzoic acid. *Solubility.*—1 in 5 of alcohol (90 per cent.). Easily in ether or potash.

COMPOSITION.—The chief constituents are—(1) *Benzoic acid* (see p. 570), 12 to 20 per cent. (2) Cinnamic acid, $C_9H_9O_2$, a trace. (3) Resins. (4) Volatile oil.

Preparations.

1. **Adeps Benzoatus.**—Benzoated lard. Benzoin, 1½; lard, 50.

2. **Tinctura Benzoini Composita.** *Synonym.*—Friar's balsam. Benzoin, 8; prepared storax, 6;

balsam of tolu, 2; Socotrine aloes, $1\frac{1}{2}$; alcohol (90 per cent.), 80. Macerate.

Dose, $\frac{1}{2}$ to 1 fl. dr.

Benzoin is also contained in Unguentum Cetacei (1 in 50). *Benzoated lard is contained in* several ointments.

Acidum Benzoicum.—Benzoic Acid. C_6H_5COOH.

Source.—From benzoin by sublimation and also from toluene, hippuric acid, and other organic compounds.

Characters.—Light feathery almost colourless flexible crystalline plates or needles. *Solubility.*—1 in 400 of cold water, 1 in 17 of boiling water, readily in solutions of alkalies. Sodium phosphate or borax aids its solution in water. It sublimes on heat.

Dose, 5 to 15 gr.

Preparations.

1. **Trochiscus Acidi Benzoici.**—$\frac{1}{2}$ gr. in each with a fruit basis.

2. **Tinctura Camphoræ Composita.**—2 gr. of benzoic acid to 1 fl. oz. (*see* Opium, p. 312). Mix.

3. **Tinctura Opii Ammoniata.**—9 gr. of benzoic acid to 1 fl. oz. (*see* Opium, p. 312). Mix.

Ammonii Benzoas.—$C_6H_5COONH_4$.

Source.—Neutralize benzoic acid with ammonia, and evaporate.

Characters.—Colourless laminar crystals, with odour of benzoic acid. *Solubility.*—1 in 6 of water, 1 in 30 of alcohol (90 per cent.).

Incompatibles.—Per-salts of iron, Liquor Potassæ, and acids.

Dose, 5 to 15 gr.

Sodii Benzoas.—C_6H_5COONa.

Source.—Neutralize a solution of benzoic acid with sodium carbonate, and crystallize.

Characters.—A crystalline or amorphous white powder. Odour faintly benzoic. Taste sweetish, alkaline. *Solubility.*—Easily in water, 1 in 24 of alcohol (90 per cent.).

Dose, 5 to 30 gr.

ACTION.

As far as is known, the action of benzoic acid, its salts, and benzoin, is the same. We shall therefore only here describe the actions of benzoic acid.

External.—Benzoic acid is a powerful antiseptic. The growth of many forms of bacteria is completely inhibited by a solution of 1 in 1000. In a concentrated form it is a stimulant and irritant when applied to the skin.

Internal.—The only fact about the internal action of benzoic acid that has been worked out is that when it is given by the mouth, **hippuric acid appears in the urine.** This happens by combination with a molecule of glycocoll, $C_7H_6O_2 + C_2H_5NO_2 = C_9H_9NO_3$ (hippuric acid) $+ H_2O$. The source of the glycocoll is not known. The conversion probably takes place in the kidneys, for after giving large doses of benzoic acid it alone can be found in the blood, and if the renal arteries are tied no hippuric acid is formed, but if only the ureters are tied it is formed. Also benzoic acid has been successfully converted into hippuric acid by passing blood containing benzoic acid, but no glycocoll, slowly through the kidneys removed directly after death. Hippuric acid has been found in the urine of new-born children when benzoic acid has been given to the mother shortly before delivery. If hippuric acid is given by the mouth benzoic acid is found in the blood, but hippuric reappears in the urine. The hippuric acid in the urine **renders alkaline urine acid,** and it stimulates and disinfects the urinary mucous membrane. Occasionally succinic as well as hippuric acid appears in the urine.

Benzoic acid or some derivative of it is probably excreted in the bronchial secretion, for the bronchial mucous membrane is stimulated by the administration of benzoic acid, the mucus being increased in quantity and disinfected. The acid is therefore **expectorant.** The same effects are brought about if the vapour of benzoic acid is inhaled.

It is said also to be excreted by the skin and salivary glands, and thereby to increase their activity. It is slightly diuretic.

Benzoic acid and its salts are antipyretic, and it is stated that they are even more powerful than salicylic acid. How they produce a fall of temperature is not known. Metabolism is believed to be generally increased.

THERAPEUTICS.

External.—Lint soaked in the compound tincture is a very favourite dressing for wounds and sores of all sorts. Its chief advantage is the antiseptic power it possesses. Its stimulating effect is also valuable.

Internal.—*Lungs.*—Benzoin, benzoic acid and its compounds are very commonly employed as stimulating disinfecting expectorants in cases of bronchitis or phthisis in which the expectoration is foul and scanty. The vapour from a mixture of a pint of water at 140° F. and a fluid drachm of compound tincture of benzoin is often inhaled for bronchitis and laryngitis.

Urinary organs.—Benzoic acid is a most valuable drug for acidifying the alkaline decomposing urine which is formed in pyelitis and cystitis, and for stimulating and disinfecting the urinary tract in the same conditions. Benzoate of ammonium is so much more soluble than benzoic acid that it is to be preferred to it. Spirit of chloroform covers the taste. It may with advantage be combined with urinary sedatives, as tincture of hyoscyamus.

Benzoic acid has been used in Germany instead of salicylic acid for rheumatic fever.

CHERRY LAUREL.

Laurocerasi Folia.—Cherry Laurel Leaves. The fresh leaves of *Prunus laurocerasus* (Nat. Ord. *Rosaceæ*).

CHARACTERS.—Thick, coriaceous, on short strong petioles. Oblong or ovate, 5 to 7 in. long, tapering towards each end, recurved at the apex, distantly but sharply serrated, dark green, smooth and shining above, pale beneath. Prominent midrib with, on either side of it, at the base, one or two glandular depressions. Inodorous except on bruising, when they emit a ratafia-like odour.

COMPOSITION.—The chief constituents are—(1) *Laurocerasin*, a glucoside; it is a compound of amygdalin and amygdalic acid. By the same changes as is the case with bitter almonds (*see* p. 539), in the presence of moisture, an oil, prussic acid, and glucose are formed. (2) *Emulsin.*

Preparation.

Aqua Laurocerasi.—Made by distillation, and *standardized* by adding either water or hydrocyanic acid till the strength of the distillate is 0·1 *per cent. of hydrocyanic acid.* That is to say, the relative strength of Acidum Hydrocyanicum Dilutum and Aqua Laurocerasi is as 20 to 1.

INCOMPATIBLES.—Metallic salts.

Dose, ½ to 2 fl. dr. (note the dose).

ACTION AND THERAPEUTICS.

Aqua Laurocerasi is not often employed, for, owing to the volatilization of the prussic acid, its strength is inconstant. Its actions are the same as those of dilute hydrocyanic acid (*see* p. 301). It is given as a flavouring agent.

ARAROBA.

Araroba.—*Synonyms.*—Goa Powder; Crude Chrysarobin. A substance found in cavities in the trunk of *Andira araroba* (Nat. Ord. *Leguminoseæ*), freed as much as possible from fragments of wood, dried and powdered.

CHARACTERS AND TESTS.—The powder varies from brownish-yellow to umber brown. It should yield to hot chloroform not less than 50 per cent. of a substance which, after evaporating and drying, should have the characters of chrysarobin.

Used for making chrysarobin.

CHRYSAROBIN.

Chrysarobinum.—Chrysarobin.

Source.—Obtained from Araroba by extracting with hot chloroform, evaporating to dryness and powdering.

Characters.—A light brownish-yellow minutely crystalline powder, tasteless and inodorous. *Solubility.*—Very sparingly in water, and sparingly in alcohol (90 per cent.).

Composition.—The 'chief constituents are (1) a definite chemical substance also known as *chrysarobin. Synonyms.*—Rhein, Chrysophan (*see* p. 433). $C_{30}H_{26}O_7$. In the fresh plant it probably exists as a glucoside, but this is slowly oxidized into chrysophanic acid, $C_{10}H_8O_3$, and glucose. (2) Chrysophanic acid.

Preparation.

Unguentum Chrysarobini.—Chrysarobin, 1; benzoated lard, 24.

Action.

External.—It is a powerful **irritant** to the skin, which it stains yellowish brown. Linen is stained the same colour. (The stain may be removed by a weak solution of caustic soda or chlorinated lime.) It is antiparasitic.

Internal.—It is cathartic and very irritating to the stomach and bowels, causing vomiting and purging. It is excreted by the kidneys, and stains the urine yellow.

Therapeutics.

It is used as an antiparasitic in ringworm, and to excite healthy inflammation in chronic cutaneous diseases, especially psoriasis and acne rosacea. It has also been given internally for skin diseases, but as it is so irritating this practice is not advisable.

GROUP XVI.

Vegetable drugs used only as colouring agents. Saffron, Red Sanders-wood.

SAFFRON.

Crocus.—Saffron. The dried stigmas and tops of the styles of *Crocus sativus* (Nat. Ord. *Iridaceæ*). Spain.

CHARACTERS.—Each portion, about 1 in. long, consists of three thread-like, orange-red stigmas, thickened and tubular above, notched at the extremities, and united below to the top of the yellow style. Flexible, unctuous to touch. Odour strong, aromatic. Taste bitter, aromatic. Rubbed on the finger leaves an intense yellow stain. Colours warm water orange yellow. Pressed between filter-paper should leave no oily stain.

COMPOSITION.—The chief constituents are—(1) *Polychroite or Crocin*, an orange-red glucoside. (2) A volatile oil.

IMPURITIES.—Marigold, saffron petals, chalk, oil, &c.

Preparation.

Tinctura Croci.—Crocus, 1; alcohol (60 per cent.), 20.

Dose, 5 to 15 m. Macerate.

Saffron is contained in Decoctum Aloës Compositum and Tinctura Cinchonæ Composita.

ACTION AND THERAPEUTICS.

Saffron is only employed to colour preparations. It was largely used in B. P. 1885 : *e.g.* Pulvis Cretæ Aromaticus was coloured with it, but it is expensive.

RED SANDERS-WOOD.

Pterocarpi Lignum.—Red sanders-wood. *Synonym.*—Red sandal-wood. The heart-wood of *Pterocarpus santalinus* (Nat. Ord. *Leguminosæ*). Ceylon.

CHARACTERS. — Dense, heavy logs; dark brown externally, internally deep blood-red. Chips deep reddish brown. *Resembling sanders-wood.*—Logwood, which is less dense.

COMPOSITION.—The chief constituent is a blood-red crystalline principle, santalic acid or santalin.

Sanders-wood is contained in Tinctura Lavandulæ Composita.

ACTION AND THERAPEUTICS.

Sanders-wood is used to colour preparations.

GROUP XVII.

Vegetable substances whose action is mechanical. Cotton, Collodion, Oil of Theobroma, Quillaia, Caoutchouc, Starch, Lycopodium.

COTTON.

Gossypium.—Cotton. *Synonym.*—Cotton Wool. The hairs of the seeds of *Gossypium barbadense* (Nat. Ord. *Malvaceæ*), and of other species of *Gossypium*, from which the fatty matter has been removed. This is commonly called 'Absorbent Cotton Wool.' Ordinary cotton wool is called 'Non-Absorbent.' It contains 10 per cent. of fixed oil.

From gossypium is made—

Pyroxylinum.—Pyroxylin or Dinitrocellulose, $C_6H_8(NO_2)_2O_5$. Gossypium is immersed in a mixture of sulphuric and nitric acids, and then drained and dried. Soluble in a mixture of ether and alcohol (90 per cent.). Leaves no residue when exploded by heat.

Preparations.

1. **Collodium.**—Pyroxylin, 1; dissolved in ether, 36; and alcohol (90 per cent.), 12.
2. **Collodium Flexile.**—Collodium, 48; Canada balsam, 2; castor oil, 1.
3. **Collodium Vesicans.**—Pyroxylin, 1; dissolved in Liquor Epispasticus, 40.

ACTION AND THERAPEUTICS.

The use of cotton wool is well known.

Pyroxylin is only used to make collodion.

Collodion, when painted on the skin, rapidly dries from evaporation of the ether, and covers the skin with a thin protective film. Collodium Flexile has the same properties, but it does not crack, as collodion often does. These preparations are protective to small wounds, and are used after slight operations. If the end of the urethra or prepuce is at night closed with collodion, nocturnal incontinence may sometimes be cured.

OIL OF THEOBROMA.

Oleum Theobromatis. *Synonym.*—Cacao butter. A concrete fixed oil obtained by pressing the warm ground seeds of *Theobroma cacao* (Nat. Ord. *Sterculiaceæ*). Growing in Demerara and Mexico. Chocolate is prepared from the roasted kernels of these seeds by the addition of sugar and vanilla. Cocoa is prepared from them by partly removing the oil of theobroma by pressure and then roasting and grinding the kernels.

Characters.—Is of the consistency of tallow; yellowish, with chocolate-like odour. Taste bland and agreeable. Fracture clean. Does not become rancid on exposure to air. Melts at 86° to 95° F.

Composition.—The chief Constituents are—(1) *Stearin.* (2) A little olein. (3) An alkaloid, theobromine, $C_7H_8N_4O_2$.

Oil of theobroma is contained in all Suppositoria except those of glycerin.

Action and Therapeutics.

It is only used to make suppositories.

QUILLAIA BARK.

Quillaiæ Cortex.—*Synonyms.*—Panama bark; Soap bark. The inner bark of the tree *Quillaja saponaria* (Nat. Ord. *Rosaceæ*).

Characters.—Large flat pieces, $\frac{1}{16}$ in. thick, 2 ft. long, 4 in. wide. Outer surface brown, inner white. It imparts a soapy character to cold water, and is used to diffuse oily liquids through water.

Composition.—The chief constituent is saponin, a glucoside (*see* p. 401).

Quillaia bark is used to emulsify the tar in Liquor Picis Carbonis when it is diluted (*see* p. 462).

Preparation.

Tinctura Quillaiæ.—Bark, 1; alcohol (60 per cent.), 20. Percolate.

Dose, ½ to 1 fl. dr.

USES.

The tincture of quillaia is, on account of its soapy nature, used to aid the diffusion of oils and other insoluble bodies. As it, like senega (q.v.), contains saponin, it probably might be used more largely as an expectorant. Those who have employed it speak very favourably of it, especially in cases in which the object is to promote free expectoration of mucus which is accumulating in the chest.

CAOUTCHOUC.

Caoutchouc.—India-rubber. The prepared milk juice of *Hevea brasiliensis* and probably other species (Nat. Ord. *Sapotaceæ*). Known in commerce as Para rubber.

CHARACTERS.—Well known.

COMPOSITION.—Caoutchouc, $(C_5H_8)_n$, is polymeric with and closely related to the terpenes. It combines readily with sulphur to form vulcanized india-rubber.

Preparation.

Liquor Caoutchouc. — India-rubber, 1 oz.; benzol, 10 fl. oz.; carbon bisulphide, 10 fl. oz.

Used to make Charta Sinapis.

STARCH.

Amylum.—Starch. The starch procured from the grains of wheat, *Triticum sativum;* maize, *Zea mays;* rice, *Oryza sativa* (Nat. Ord. *Graminaceæ*).

CHARACTERS.—Well known.

Preparation.

Glycerinum Amyli.—Starch, 1; glycerin, 6½; water, 1½.

Starch is contained in Pulvis Tragacanthæ Compositus.

ACTION AND THERAPEUTICS.

Starch is chiefly employed for its mechanical properties, on account of which it is used as a basis for dusting powders and insufflations. Mucilage of starch may be used as a basis for ointments, and to suspend insoluble powders or oils ; it is very handy as a basis for enemata, but does not keep well and is therefore not suitable as a vehicle for a mixture.

Lycopodium.—(Not official.)

Club-moss Spores. The spores of common club-moss, *Lycopodium clavatum.*

CHARACTERS.—A fine, mobile, pale yellow powder. Odour and taste, none.

ACTION AND THERAPEUTICS.

As lycopodium has a great power of absorbing oils and oleo-resins, it may be used to form these into pills, especially as it protects hygroscopic substances, for it is powerfully repellent to water. It is useful as a dusting powder, and also as a basis for insufflations.

GROUP XVIII.

Vegetable substances whose action is not known.

Guaiacum, Pareira, Sarsaparilla, Sassafras, Hemidesmus, Bael Fruit, Oleum Gynocardiæ.

GUAIACUM WOOD.

Guaiaci Lignum. *Synonym.*—Lignum vitæ. The heart-wood of *Guaiacum officinale* or of *Guaiacum sanctum* (Nat. Ord. *Zygophylleæ*). West Indies.

CHARACTERS.—Dark greenish brown, dense, hard, and heavier than water. Taste acrid and aromatic. Odour, if rubbed or heated, faintly aromatic.

COMPOSITION.—The chief constituent is the resin, 20 to 25 per cent. (q.v.).

Guaiacum wood is contained in Liquor Sarsæ Compositus Concentratus.

Guaiaci Resina.—Guaiacum Resin. The resin obtained from the stem of *Guaiacum officinale* or of *Guaiacum sanctum.*

CHARACTERS.—Usually in large masses, occasionally in roundish tears. Surface brown or greenish brown, covered, after exposure, with a greenish powder. Fracture clean and glassy. Odour balsamic. When chewed gives acrid sensation in the throat. An alcoholic solution strikes a clear blue colour when applied to the inner surface of a potato (fresh protoplasm), or when treated with tincture of iron. Guaiacum resin on dry distillation yields amongst other substances cresol and *guaiacol*, also found in creosote (*see* pp. 296 and 297). *Resembling guaiacum resin.*—Myrrh, scammony, benzoin, aloes, and resin, but these have no green tinge.

COMPOSITION.—The chief constituents are three resins—Guaiaconic acid, $C_{19}H_{20}O_5$ (70 per cent.); guaiac acid, resembling benzoic acid; and guaiaretic acid. These are insoluble in water, soluble in alkalies, but precipitated on neutralization.

INCOMPATIBLES.—Mineral acids, spirit of nitrous ether.

Dose, 5 to 15 gr.

Preparations.

1. **Mistura Guaiaci.**—Guaiacum resin, 2; sugar, 2; tragacanth, $\frac{1}{3}$ (to suspend the resin); cinnamon water, 80. (The resin very quickly falls.)

Dose, $\frac{1}{2}$ to 1 fl. oz.

2. **Tinctura Guaiaci Ammoniata.**—Guaiacum resin, 4 oz.; oil of nutmeg, 30 ♏; oil of lemon, 20 ♏; strong solution of ammonia, $1\frac{1}{2}$ fl. oz.; alcohol (90 per cent.), to make 20 fl. oz. Macerate. As the resin is precipitated on dilution of the ammonia it must be suspended by adding mucilage or yolk of egg.

Dose, $\frac{1}{2}$ to 1 fl. dr.

3. **Trochiscus Guaiaci Resinæ.**—3 gr. in each, with a fruit basis.

4. **Pilula Hydrargyri Subchloridi Composita.**—1 in $2\frac{1}{2}$ (*see* p. 192).

ACTION.

External.—None.

Internal.—Guaiacum resin gives rise to an acrid feeling in the throat and a sensation of heat in the epigastrium. It increases the secretions and movements of the intestine and stomach. Large doses are gastro-intestinal irritants, causing vomiting and purging. It reflexly stimulates the heart.

THERAPEUTICS.

Internal.—Guaiacum resin is so nasty and its value so doubtful that it is rarely ordered. It is used empirically, sometimes successfully, for chronic sore throat, especially if the subject has had syphilis. The mixture is said to be a more efficacious preparation than the tincture. Thirty grains of the powder itself may be placed on the back of the throat and swallowed, but the lozenge is to be preferred. Guaiacum is a mild purgative, and it has been given as a pill in chronic constipation; this property accounts for its presence in compound calomel pills. Lately it has been strongly recommended by Sir Alfred Garrod as a means of warding off attacks of gout. For this purpose 12 grains of the powdered resin may be taken in a cachet for an indefinite period, even several years. It is well to follow it by a draught of effervescing citrate of lithium. It was formerly employed in chronic rheumatism.

PAREIRA.

Pareiræ Radix.—Pareira Root. The dried root of *Chondrodendron tomentosum* (Nat. Ord. *Menispermaceæ*).

CHARACTERS.—Long cylindrical twisted pieces, $\frac{3}{4}$ to 2 in. thick; bark thin, blackish brown, with longitudinal furrows and transverse ridges and fissures. Internally yellowish or brownish grey, with circles of porous wood and large medullary rays. Waxy when cut. Bitter taste; no odour.

COMPOSITION.—The chief constituent is an alkaloid, *buxine* (also called pelosine or cissampeline), identical with berberine.

INCOMPATIBLES.—Per-salts of iron, salts of lead, and tincture of iodine.

Preparation.

Extractum Pareiræ Liquidum. — Aqueous with a little alcohol to keep it.

Dose, ½ to 2 fl. dr.

ACTION AND THERAPEUTICS.

The action of pareira is believed to closely resemble that of buchu. It is used empirically in chronic inflammation of the genito-urinary tract, such as pyelitis, cystitis, gonorrhœa, and gleet.

SARSAPARILLA.

Sarsæ Radix.—Sarsaparilla. The dried root of *Smilax ornata* (Nat. Ord. *Liliaceæ*). Costa Rica. Commonly known as Jamaica Sarsaparilla.

CHARACTERS.—Very long, usually folded into bundles about 18 in. long, 4 to 5 in diameter, bound together by a long sarsaparilla root. Roots furrowed, never thicker than a goose-quill, dark brown with numerous branched rootlets. Odour none. Taste mucilaginous, and when chewed feebly bitter and faintly acrid. *Resembling Sarsæ Radix.*—Senega twisted and keeled, hemidesmus cracked transversely.

COMPOSITION.—The chief constituents are—(1) Smilacin or parellin, an acrid neutral principle closely resembling saponin. (2) Resin, 2½ per cent. (3) Traces of a volatile oil.

INCOMPATIBLES.—Alkalies.

Preparations.

1. Extractum Sarsæ Liquidum.—Alcoholic with glycerin.

Dose, 2 to 4 fl. dr.

2. Liquor Sarsæ Compositus Concentratus. —Sarsaparilla, 20; sassafras, 2; guaiacum wood, 2; liquorice, 2; mezereon, 1; alcohol (90 per cent.), 4½; water, q. s. Made by boiling and concentration (*see* p. 18).

Dose, 2 to 8 fl. dr.

ACTION AND THERAPEUTICS.

Sarsaparilla is not known to have any physiological action. It is never given alone, therefore we are ignorant of its therapeutical effects. Probably it has none.

SASSAFRAS.

Sassafras Radix.—The dried root of *Sassafras officinale* (Nat. Ord. *Laurineæ*). North America.

CHARACTERS.—Large branched pieces with some bark on them. Bark externally greyish brown, rough; internally smooth, glistening, rusty brown. Odour agreeable, aromatic. Taste astringent, aromatic. Wood soft, light, greyish yellow, taste and odour like bark.

COMPOSITION.—The chief constituents are—(1) A volatile oil. (2) Sassafrin, a peculiar neutral crystalline principle. (3) Resin, tannic acid, &c.

Sassafras is contained in Liquor Sarsæ Compositus Concentratus.

ACTION AND THERAPEUTICS.

The external and internal action of sassafras is, as far as is known, the same as that of volatile oils generally, but it is never administered in England except in Decoctum Sarsæ Compositum, and what part it plays there is unknown.

HEMIDESMUS.

Hemidesmi Radix.—The dried root of *Hemidesmus Indicus* (Nat. Ord. *Asclepiadaceæ*). *Synonym.*—Indian sarsaparilla. India.

CHARACTERS.—Cylindrical, long, rigid, twisted, longitudinally furrowed, $\frac{1}{4}$ in. thick; the yellowish-brown corky layer easily separable from the rest of the bark, which is annularly cracked. Odour fragrant. Taste sweetish, slightly acid. *Resembling hemidesmus.*—Sarsaparilla, ipecacuanha, senega, but they have no cracks.

COMPOSITION.—The chief constituents are—(1) Hemidesmine. (2) Tannin.

Preparation.

Syrupus Hemidesmi. — Hemidesmus, 4 oz.; sugar, 28 oz.; boiling water, 1 pint.

Dose, $\frac{1}{2}$ to 1 fl. dr.

ACTION AND THERAPEUTICS.

Hemidesmus is chiefly used in India and for the same purposes as sarsaparilla. It is doubtful whether it has any particular action.

Belæ Fructus.—(Not official.)

The dried half-ripe fruit of *Ægle marmelos* (Nat. Ord. *Rutaceæ*). From Malabar and Coromandel.

CHARACTERS.—Roundish fruit, the size of a large orange. Usually imported in fragments of the hard woody rind, with adherent dried pulp and seeds.

COMPOSITION.—Not known.

ACTION AND THERAPEUTICS.

As imported, bael fruit is probably useless; it is therefore rarely employed out of India, where an extract of the fresh fruit is used for the treatment of diarrhœa and dysentery. It contains but little tannin, and its mode of action is not known.

Oleum Gynocardiæ.—Chaulmoogra Oil.—(Not official.)

The expressed oil from the seeds of *Gynocardia odorata* (Nat. Ord. *Bixineæ*).

CHARACTERS.—Soluble in ether, chloroform, and alcohol.

COMPOSITION.—Its chief constituent is gynocardic acid, a yellowish oily body with a burning taste.

Dose, 5 to 20 m. in a capsule.

ACTION.

Chaulmoogra oil has been much used in leprosy, for the bacilli present in the blood have diminished in number during its administration, but it does not cure the disease. An ointment (3 fl. dr. to 1 fl. oz. of lanolin) has been used as a stimulant in chronic eczema and psoriasis.

SECTION II.—PHARMACOPŒIAL SUBSTANCES DERIVED FROM THE ANIMAL KINGDOM.

MUSK.

Moschus.—Musk. The dried secretion from the preputial follicles of *Moschus moschiferus*, the musk deer (Nat. Ord. *Ruminantia*). Central Asia.

CHARACTERS.—In irregular, unctuous, dark reddish-brown or reddish-black grains. Odour strong, peculiar, diffusible, penetrating, persistent. The musk sac, which is situated between the navel and the genitals, but nearer the latter, under the skin and lying on the muscles of the abdomen, occurs in commerce as a roundish oval sac, 1½ to 2 in. in diameter, nearly smooth on one side, and covered on the other or outer side by brownish-yellow or greyish adpressed, bristle-like hairs, concentrically arranged around a nearly central orifice. It contains the grains of musk. It is loculated, and is a special structure, not the preputial follicles as stated by the pharmacopœia. Its orifice is just in front of the penis.

COMPOSITION.—This is not known. The odorous principle is probably a product of decomposition, constantly being formed; complete drying destroys the odour, but it returns after water is added. Musk also contains fats, oils, salts, &c.

IMPURITIES.—On account of the very high price of musk, the sac is often partly filled with dried blood and all sorts of impurities, and it is then sewn up again.

Dose, 5 to 10 gr. as a pill, or suspended with acacia.

ACTION.

Musk is a very powerful **diffusible stimulant,** especially to the heart and nervous system. How it acts is not known. It also stimulates the respiratory centre. Occasionally it produces headache and nausea.

THERAPEUTICS.

It has been used, and apparently with great success, in the collapse and prostration of long-continued severe diseases, such as typhoid fever and pneumonia. Various functional nervous diseases, as hysteria, are occasionally treated with it. Its high price limits its use. It is usually given as a pill.

SUET.

Sevum Præparatum.—The internal fat of the abdomen of the sheep, *Ovis aries* (Nat. Ord. *Ruminantia*), purified by melting and straining.

Suet is contained in Unguentum Hydrargyri.

CURD SOAP.

Sapo Animalis.—Curd Soap. Soap made with sodium hydroxide and a purified animal fat consisting principally of stearin. It is chiefly stearate of sodium, and contains about 30 per cent. of water.

Curd soap is contained in Extractum Colocynthidis Compositum, Linimentum Potassii Iodidi cum Sapone, and Pilula Scammonii Composita.

ACTION AND THERAPEUTICS.

Curd soap is used as a basis.

ADEPS LANÆ.

Adeps Lanæ.—Wool Fat. The purified cholesterin fat of sheep's wool. For Adeps *see* p. 590.

SOURCE.—Sheep's wool washed with cold water, then submitted to heat and pressure, yields impure wool fat. This is purified by melting, washing with an alkali, and then washing with an acid while it is heated.

CHARACTERS.—Semi-transparent, pale yellow, tenacious body. Ignited it burns with a sooty flame. Melts between 100° and 112° F. Odour faintly like sheep's wool. *Solubility.*—Freely in chloroform and in ether, partially in alcohol. Insoluble in water, but on vigorous stirring takes up 1¼ times its own weight.

Adeps Lanæ Hydrosus.—Hydrous wool fat. *Synonym.*—Lanoline.

SOURCE.—Incorporate 3 oz. of water with 7 oz. of wool fat, and melt in a warm mortar.

CHARACTERS.—Opaque, very pale yellow, softer than wool fat. On heating it separates into an upper oily and a lower aqueous layer. Glycerin abstracts the water.

Adeps Lanæ Hydrosus is contained in Unguentum Conii and Unguentum Hamamelidis.

ACTION AND THERAPEUTICS.

Hydrous wool fat when gently rubbed on the skin is more quickly absorbed than most fats; hence it is a useful basis if we wish to administer substances—as, for example, mercury—by inunction, or if we want an ointment to be absorbed.

Milk, Artificial Human.—(Not official.)

PREPARATION.—Take half a pint of skimmed milk, heat it to about 96° F., and put into the warmed milk a piece of rennet an inch square or a teaspoonful of essence of rennet. Put the milk in a fender, or over a lamp, until it is quite warm. As soon as it is set remove the rennet if that has been used, break up the curd into small pieces with a knife, and let it stand for ten or fifteen minutes; the curd will then sink. Then pour the whey into a saucepan and boil quickly. Measure one third of a pint of this whey, and dissolve in it, while it is hot, 110 grains of sugar of milk. When this third of a pint of whey is cold, add to it two thirds of a pint of new milk and two teaspoonfuls of cream and stir. The food should be made fresh every twelve hours, and warmed as required. The piece of rennet, when taken out, can be kept in a cup and used for ten days or a fortnight. Care should be taken to select an essence of rennet which does not make the milk taste.

ACTION AND THERAPEUTICS.

Artificial human milk is invaluable as a food for infants whose mothers cannot suckle them. Many case of infantile diarrhœa, indigestion, and sickness can be cured by substituting this milk for the usual milk and water or infants' food. Some large dairy firms supply it, but it is cheaper to make it at home, and the above directions are easily carried out. When bought it is often sterilized and sold in air-tight bottles. It should be remembered that a long-continued diet of sterilized milk may, in children, cause scurvy rickets.

Milk, Peptonized.—(Not official.)

PREPARATION.—Mix a pint of milk with 5 fluid ounces of water. Heat to 140°, and add Liquor Pancreaticus (Benger's)

2 fl. dr., or Zymine (Fairchild's Extractum Pancreatis) 5 gr., and sodium bicarbonate, 20 grains. Leave the mixture at the ordinary temperature of the room for three hours, or if kept at about 135° F., for about half an hour, then heat for a moment to boiling-point.

Action and Therapeutics.

Peptonized milk is used in many conditions in which it is thought that the gastric digestion is too feeble to digest ordinary milk, or in which it is desired, as sometimes, for instance, in typhoid fever, to avoid the curdling of milk in the stomach. Milk should always be peptonized before being introduced into an enema. A usual nutrient enema consists of the yolk of an egg and milk up to four fluid ounces. This mixture may be peptonized in just the same way and with the same quantity of peptonizing agents as the pint of milk. Thirty grains of common salt should be added to the enema before use.

Koumiss, or Kumyss.—(Not official.)

This is largely drunk by the Tartars, who prepare it by fermenting mare's milk. It may be made by dissolving ½ oz. of grape sugar in 4 fl. oz. of water and 20 gr. of yeast in 4 fl. oz. of cow's milk. Pour both into a quart bottle, which is then filled up with milk, corked, wired, and put in a cool place and frequently shaken for four days.

Uses.

It contains a little alcohol and is extremely useful as a stimulant food in convalescence, in phthisis, and other conditions of exhaustion. It is often borne by the stomach when all other food is vomited. Several dairy firms sell it.

SUGAR OF MILK.

Saccharum Lactis.—Sugar of milk. *Synonym.*—Lactose, $C_{11}H_{22}O_{11},H_2O$. A crystallized sugar obtained from the whey of milk.

Characters.—Crystals or crystalline masses, greyish white, translucent, hard; scentless; faintly sweet; gritty when chewed.

Sugar of milk is contained in Pulvis Elaterini Compositus, Extractum Belladonnæ Alcoholicum, Extractum Nucis Vomicæ, Extractum Opii, Extractum Physostigmatis, and Extractum Strophanthi.

ACTION AND THERAPEUTICS.

Sugar of milk is used as a vehicle for the trituration of powders, because being very hard it thoroughly divides them, and also it is but slightly deliquescent. For these reasons it is used as a diluent to get extracts to the required strength. It is employed to sweeten infants' food.

OX GALL.

Fel Bovinum Purificatum.—Purified Ox Bile. The purified gall of the ox, *Bos taurus* (Nat. Ord. *Ruminantia*).

SOURCE.—Evaporate fresh ox bile to one quarter its bulk. Wash thoroughly with alcohol (90 per cent.), distil off the alcohol. Evaporate what remains to the consistence of an extract.

CHARACTERS.—Yellowish green. Soluble in water and in alcohol. Taste partly sweet, partly bitter.

Dose, 5 to 15 gr.

ACTION AND THERAPEUTICS.

Ox gall has been used as a cholagogue purgative in cases of constipation in which the pale colour of the fæces indicates a deficient secretion of bile. An enema of twenty grains or more of it dissolved in an ounce or two of water is very useful in cases of impacted fæces, in which the rectum is so full that there is not sufficient room for a larger enema.

GELATIN.

Gelatinum.—The air-dried product of the action of boiling water on such tissues, as skin, tendons, ligaments, and bones.

CHARACTERS.—In translucent, almost colourless sheets or shreds. The solution in hot water is colourless and inodorous; it solidifies to a jelly on cooling. It is insoluble in alcohol or ether. Its aqueous solution is precipitated by tannin.

Gelatin is a constituent of Suppositoria Glycerini and all Lamellæ.

ACTION AND THERAPEUTICS.

It is useful as a base for suppositories, pessaries, bougies, discs, gelatin capsules and lozenges, and as a coating for pills.

LARD.

Adeps.—Lard. The purified fat of the hog, *Sus scrofa* (Nat. Ord. *Pachydermata*).

Lard is contained in Emplastrum Cantharidis and many ointments. Benzoated lard has been described (p. 569).

Adeps induratus (indurated lard), which is ordinary lard deprived of a portion of its oil by pressure, may be used in India and the Colonies when the high temperature renders ordinary lard too soft for use in ointments.

ACTION AND THERAPEUTICS.

Lard is an emollient, and is used as a basis for ointments. The benzoated variety has the advantage of not quickly turning rancid.

PEPSIN.

Pepsinum.—An enzyme obtained from the mucous lining of the fresh and healthy stomach of a pig, sheep, or calf.

CHARACTERS.—A lightish yellow-brown or white powder, or pale yellow translucent grains or scales. Odour faint. Taste slightly saline. Very sparingly soluble in water or alcohol.

TEST.—If 12·5 grammes of coagulated white of fresh eggs, 125 c.c. of a 0·2 per cent. solution of hydrochloric acid, and 0·005 gramme of pepsin be digested together for six hours at 105° F., the white of egg should dissolve, forming an almost clear solution.

Dose, 5 to 10 gr.

Preparation.

Glycerinum Pepsini.—Pepsin, 800 gr.; diluted hydrochloric acid, 110 ♏; glycerin, 12 fl. oz.; distilled water to make 20 fl. oz. *Strength.*—1 fl. dr. represents 5 gr. of pepsin.

Dose, 1 to 2 fl. dr.

ACTION AND THERAPEUTICS.

Pepsin may be given to help gastric digestion in those in whom from old age or long illness the secretion of gastric juice is deficient. Thus, for example, it is useful in convalescence from acute illnesses or in cases of cancer of the stomach. It is of no use as an aid to the digestion of fatty or carbo-hydrate food. It should be given in a powder or pill directly after meals, and should be followed in about half an hour by a dose of hydrochloric acid in the proportion mentioned in the above test. The pepsin should be tested before use, as many preparations in the market are inert powders. The best form in which to give it is the Glycerinum Pepsini.

Pepsin may be used to predigest albuminous food, either for administration by the mouth or the rectum. Often this is better than giving pepsin internally, for morbid processes may be going on in the stomach which prevent digestion. The rectum has very feeble powers of digestion, and therefore nutrient enemata or suppositories should always be predigested. It is found that for predigestion Liquor Pancreatis is usually a more reliable preparation than pepsin (*see* p. 592). Both should be employed with judgment, for there is a likelihood that if artificial digestion be used too long the digestive functions of the stomach may atrophy from want of use.

The following directions for peptonizing meat may be followed. Take one pound of lean meat, pulp it finely, add six times its weight of water containing 0·2 per cent. of hydrochloric acid and 120 grains of pepsin. Digest at 120° F. in a porcelain digester for five or six hours with frequent stirring. Then neutralize with sodium carbonate, boil and filter. Evaporate the filtrate on a water-bath till it is of the consistency of a soft extract.

Peptonized meat suppositories are often very valuable. To make one suppository 30 grains of the above extract is mixed with 40 grains of oil of theobroma, and moulded in a conical mould.

PANCREATIC SOLUTION.

Liquor Pancreatis.—A solution of the digestive principles of the fresh pancreas of the pig. It is most active when the animal from which it has been obtained has been fed shortly before being killed.

Source.—One part of the pancreas, finely divided, is digested with 4 parts of alcohol (20 per cent.) for seven days.

Test.—If 2 c.c. with 0·2 grm. of sodium bicarbonate and 20 c.c. of water be added to 80 c.c. of milk, and the mixture kept at 113° F. for 1 hr., coagulation should no longer occur on the addition of nitric acid.

Action and Therapeutics.

Liquor pancreatis has the power of converting starch into sugar, albumen and fibrin into peptones, and first curdling and then peptonizing milk. It will not act in an acid medium or above 140° F. The directions for peptonizing milk are given on p. 587. Liquor pancreatis and sodium bicarbonate used in the same proportions as in peptonizing milk will peptonize warm farinaceous foods. It may also be added to enemata with sodium bicarbonate, or it and the bicarbonate may be taken one to two hours after meals.

THYROID GLAND.

Thyroideum Siccum.—Dry Thyroid. A powder prepared from the fresh and healthy thyroid gland of the sheep.

Source.—Remove the fat and connective tissue directly the sheep is killed. Reject cystic, hypertrophied, or otherwise abnormal glands. Mince. Dry at 90° to 100° F. Powder the dried product. Remove all fat by washing with petroleum spirit and again dry.

Characters.—Light dull brown powder with faint meat-like odour and taste, and free from odour of putrescence. Liable to become damp and then deteriorates.

Dose, 3 to 10 gr.

Liquor Thyroidei.—A liquid prepared from the fresh and healthy thyroid gland of the sheep.

Source.—The fresh healthy glands are bruised with, for each gland, 34 ♏ of glycerin and 34 ♏ of a 0·5 per cent. solution of phenol. Stand for 24 hours, strain, and add enough of the phenol to make 100 ♏.

Characters.—Pinkish turbid liquid free from odour of putrescence. To be freshly prepared and kept in stoppered bottles. *Strength.*—100 ♏ represent 1 gland.

Dose, 5 to 15 m.

Action and Therapeutics.

It is known that human beings or monkeys whose thyroid is excised become myxœdematous, and that all sufferers from myxœdema have atrophied thyroid glands. If a preparation of sheep's thyroid is given to patients suffering from myxœdema, all the symptoms disappear, usually in about six weeks. The effect is as striking as anything in medicine. It is best to begin with small doses thrice a day, to gradually increase them till full doses are given, and when all the symptoms have disappeared it will be necessary for a small dose to be taken three times a week to prevent recurrence. When the treatment was first introduced the glands were eaten, or transplanted under the skin, or the extract administered subcutaneously; but equally good results are obtained by giving the liquid extract or the powder by the mouth, compressed tablets of which are very convenient and much used. Sporadic cretinism is also marvellously benefited by thyroid preparations, and improvement has occasionally followed their use in obesity. Chronic psoriasis, which has resisted all other treatment, often disappears if the patient be put to bed and take daily enough of thyroid preparations to keep him on the brink of poisoning by them, but unfortunately the disease often returns when the treatment is discontinued.

Poisoning.—An overdose of a thyroid preparation causes a rapid pulse, headache, nausea, restlessness, and rarely delirium. These symptoms are termed 'Thyroidism.' Very large doses taken for a long time make the patient thin.

Extracts of many other organs, especially bone-marrow and thymus, have been employed in medicine, but there is so little evidence that they are of any use that the only one that need be referred to is—

Suprarenal Extract.—(Not official.)

This is prepared from the suprarenal capsules of sheep. Some writers claim that it benefits Addison's disease, but others have failed to notice any improvement. Lately it has been recommended for exophthalmic goitre. It has been shown experimentally to constrict the small arteries and raise blood-pressure, to inhibit the heart through the vagus, and to produce a muscle curve like veratria. The active principle is only in the medulla of the gland. It is best given as an extract, 1 gr. of which made into a tabloid or pill corresponds to 15 gr. of the gland. Treatment should begin with 1 gr. of such an extract thrice daily, but the dose should be rapidly pushed. The gastric contents have no effect on such an extract.

SPERMACETI.

Cetaceum.—Spermaceti. A concrete fatty substance obtained, mixed with oil, from the head of the sperm whale, *Physeter macrocephalus* (Nat. Ord. *Cetacea*), inhabiting the Pacific and Indian Oceans. It is separated from the oil by filtration and pressure, and is then purified.

CHARACTERS.—Crystalline, pearly white, glistening, translucent masses with little taste or odour. *Solubility.*—Not in water, but soluble in ether, chloroform, or boiling alcohol.

COMPOSITION.—It is cetylic alcohol, $C_{16}H_{33}OH$ in combination with palmitic acid, $HC_{16}H_{31}O_2$, forming a fat, cetin, $C_{16}H_{33},C_{16}H_{31}O_2$.

Preparation.

Unguentum Cetacei.—Spermaceti, 20 oz.; white beeswax, 8 oz.; benzoin, 2 oz.; almond oil, 72 oz.

ACTION AND THERAPEUTICS.

Spermaceti is used as an emollient and as a basis for ointments.

COD-LIVER OIL.

Oleum Morrhuæ.—The oil extracted from the fresh liver of the cod, *Gadus morrhua* (Nat. Ord. *Teleostei*), by a heat not exceeding 180° F., and from which the solid fat has been separated by filtration at 23° F. Norway coast.

CHARACTERS.—Pale yellow, with a slight fishy odour, and a bland fishy taste. Sp. gr. 0·920—0·930.

COMPOSITION.—The chief constituents are—(1) *Olein* (85 per cent.), which is a fluid fixed oil, and is oleate of glyceryl. Oleic acid is $C_{18}H_{31}O_2$, glyceryl is C_3H_5, and olein is $C_3H_5(C_{18}H_{33}O_2)_3$. It is the most abundant constituent of cod-liver oil. (2) Palmatin and stearin (10 per cent.). (3) Free fatty acids, as oleic, palmitic, stearic. (4) Trimethylamine. (5) Traces of iodine, bromine, bile salts, cholesterin, sulphuric acid and phosphoric acid. (6) Many alkaloids. Gaduin, which has been described, is probaby a decomposition product. The composition of the morrhuol of commerce is uncertain.

Dose, 1 to 4 fl. dr.

ACTION.

External.—Cod-liver oil is a bland unirritating oil. If it is desired to administer it in cases in which it is rejected by the stomach, it may be rubbed into the skin. The oil is certainly absorbed when applied in this way.

Internal.—*Gastro-intestinal tract.*—Cod-liver oil, even more than other oils, is liable to cause indigestion, nausea, and sickness. Large doses may set up diarrhœa. It is **more readily absorbed** than other oils. Loops of intestine have been isolated in the lower animals, and into each loop different oils have been injected. The intestines are returned to the abdominal cavity, and after some time the animal is killed and the loops are opened. It is always found that cod-liver oil has been more rapidly absorbed than any other oil. The facility with which cod-liver oil is absorbed is also shown by the fact that it often cannot be recognised in the fæces, although equal quantities of other oils taken by the mouth are passed unaltered. Some authorities believe that the superior absorbability of cod-liver oil depends upon the biliary principles contained in it, but this is doubtful; others think that it is because the presence of free acids facilitates saponification and emulsion. Certainly it contains more free fatty acids than other oils, and it also emulsifies much more readily.

Tissues.—Not only is cod-liver oil more readily absorbed than other oils, but it is a better **food.** All oils lead to an increased formation of fat, but cod-liver oil is the most powerful in this respect. It reduces the colour of a solution of permanganate of potassium more readily than other oils —that is to say, it is more readily oxidized. Thus, as it is more easily absorbed and more easily oxidized, we have a partial explanation of its peculiar value in increasing the weight of the body; but the general belief is that these two facts do not wholly explain the action of cod-liver oil, and that it has some peculiar specific action not yet understood, especially upon those suffering from phthisis, for whom it may be a valuable drug.

THERAPEUTICS.

External.—The smell of cod-liver oil is so disagreeable that it should not be rubbed in externally unless this treatment be absolutely necessary.

Internal.—Cod-liver oil is of the greatest service in all varieties of tuberculous disease, the only contra-indications being high temperature, severe hæmoptysis, and dyspepsia, vomiting, or diarrhœa, whether primary or induced by the oil. Patients often improve in every way under its influence. With the same exceptions it may be administered with great advantage in rickets, and in any chronic disease associated with loss of flesh, such as long-continued suppuration, convalescence from acute disease, tertiary syphilis, and starvation. It often is of benefit in the chronic bronchitis and the chronic eczema of childhood. It is frequently given with success in neuralgia, general feebleness, despondency, and other nervous conditions. Formerly it was often prescribed for chronic rheumatism. Many persons cannot, or imagine they cannot, take it on account of its nasty taste. There are in the market several preparations of cod-liver oil in which, by careful preparation, the disagreeable taste is almost abolished. Ten minims of pure ether with a drop or two of oil of peppermint or cloves will, when mixed with a dose of cod-liver oil, often render it more palatable. Sometimes it is taken in capsules, or made into a jelly with isinglass, or a little salt is put into the mouth after the oil is taken, or the mouth is rinsed out with brandy beforehand. Sometimes it is taken in coffee, but perhaps the best way is to form an emulsion of it. A very nutritious one is made by rubbing together equal parts of maltine and cod-liver oil, and in this the oil can hardly be tasted.

The British Pharmaceutical Conference advises the following emulsion:—Cod-liver oil, 8 oz.; the yolk of two eggs; tragacanth in powder, 16 gr.; elixir of glusidum (glusidum, 24 gr.; Sod. Bicarb., 12 gr.; alcohol [90 per cent.], 1 fl. dr.; Aq. Dest., 7 fl. dr.), 1 fl. dr.; simple tincture of benzoin, 1 fl. dr.; spirit of chloroform, 4 fl. dr.; essential oil of bitter almonds, 8 ♏; distilled water to 16 fl. oz. Dose, 2 to 8 fl. dr. It is frequently wished to give cod-liver oil with iron. In that case the following preparation, in which the oil is emulsified with an alkali, will be found useful:—Cod-liver oil, 4 fl. dr.; citrate of iron and ammonium, 5 gr.; potassium carbonate, 3 gr.; glusidum, $\frac{1}{4}$ gr.; oil of caraway, 1 ♏; water to 1 fl. oz.

Ichthyol.—(Not official.)

Synonym.—Sulphoichthyolate of ammonium.

SOURCE.—A bituminous quartz containing the fossil remains of fish and other animals is distilled with sulphuric acid, and the distillate is neutralized with ammonia.

Characters.—A viscous, brownish, almost black substance, odour tarry. Soluble in water, glycerin, oils, fats, and vaseline.

Dose, 10 to 30 gr.

Sulphoichthyolates of lithium, sodium, and zinc are prepared.

Action and Therapeutics.

Ichthyol is chiefly used externally for chronic eczema and psoriasis. An ointment with lanoline and ichthyol 20 to 50 per cent. is easily made. Ichthyol has been given as a pill in 10 to 30 grain doses thrice a day for chronic rheumatism.

HONEY.

Mel Depuratum. *Synonym.*—Clarified honey.

Source.—Melt honey in a water-bath, and strain through warm flannel while hot.

Preparation.

Oxymel.—Clarified honey, liquefied, 8; acetic acid, 1; water, 1. Sp. gr. 1·32.

Dose, 1 to 2 fl. dr.

Clarified honey is contained in Confectio Piperis, Oxymel Scillæ, and Mel Boracis.

Action and Therapeutics.

Honey is demulcent, relieving dryness of the mouth and facilitating swallowing. Oxymel is a useful preparation. It is a common ingredient of cough mixtures. Honey is a mild laxative, and may be given to children for this purpose.

WAX.

Cera Flava.—Yellow Beeswax. Prepared from the honeycomb of the hive bee, *Apis mellifica* (Nat. Ord. *Hymenoptera*).

Characters.—Firm, yellowish. Odour honey-like. Not unctuous. Soluble in oil of turpentine, not in alcohol.

Composition.—It consists chiefly of Myricin (Myricyl palmitate) $C_{30}H_{61}C_{16}H_{31}O_2$.

Cera Alba.—White Beeswax. Made by bleaching yellow wax by exposure to moisture, air, and light.

Uses.

Yellow and white wax are only used as bases for many plasters and ointments, and for Pilula Phosphori.

COCHINEAL.

Coccus.—Cochineal. The dried fecundated female insect *Coccus cacti* (Nat. Ord. *Hemiptera*). Reared in Mexico and Teneriffe on *Nopalea cochinillifera* (Nat. Ord. *Cacteæ*), and on other species of *Nopalea*.

Characters.—Oval, flat or concave beneath, convex above, about $\frac{1}{5}$ in. long, transversely wrinkled, purplish black or purplish grey, easily pulverized, the powder being dark red or puce-coloured.

Composition.—The chief constituent is the glucoside *carminic acid*, $C_{17}H_{18}O_{10}$. Sulphuric acid and several other reagents precipitate from the decoction the well-known colouring matter carmine.

Preparation.

Tinctura Cocci.—Cochineal, 1; alcohol (45 per cent.), 10. Macerate.

Dose, 5 to 15 m.

Cochineal is contained in the compound tinctures of cardamoms and cinchona.

Uses.

Cochineal is only used as a colouring agent.

CANTHARIDES.

Cantharis.—Cantharides. The dried beetle *Cantharis vesicatoria*. *Synonym.*—Spanish fly (Nat. Ord. *Coleoptera*). Collected chiefly in Hungary and Russia.

Characters.—$\frac{3}{4}$ to 1 in. long, $\frac{1}{4}$ in. broad, with two long elytra or wing-sheaths of a shining coppery-green colour, under which are two thin, brownish, transparent, membranous wings. Powder greyish brown, containing shining green particles. Odour strong, disagreeable. As they are subjected to the ravages of mites and moths they should be kept in well-stoppered bottles with a little camphor.

COMPOSITION.—The chief constituents are—(1) *Cantharidin*, $C_{10}H_{12}O_4$, 0·4–1 per cent., the active principle, a fatty crystallizable body forming shining colourless plates, soluble in alcohol, ether, acetic ether, glacial acetic acid, chloroform, and oils. It is found especially in the generative apparatus, the eggs, and the blood. (2) A volatile oil, giving the odour, and said to have the same action as cantharidin. (3) A green oil, the colouring principle, closely allied to chlorophyll.

Preparations.

1. Acetum Cantharidis.—Cantharides, 2; glacial acetic acid, 10; water, 10. *Strength.*—1 in 11.

2. Emplastrum Cantharidis.—Cantharides, 3½; yellow beeswax, 2; soap plaster, ½; resin, 2; lard, 2. *Strength.*—3½ in 10.

3. Emplastrum Calefaciens.—Cantharides, 1; yellow beeswax, 1; resin, 1; soap plaster, 8; resin plaster, 13; boiling water, 5. *Strength.*—1 in 29.

4. Liquor Epispasticus.—Cantharides, 10; percolated with acetic ether, 20. *Strength.*—1 in 3.

This is twice the strength of the Liquor Epispasticus, Blistering Liquid, of the B.P. 1885.

5. Collodium Vesicans.—Liquor Epispasticus 40, in which 1 of pyroxylin is dissolved. *Strength.*—1 in 3.

6. Tinctura Cantharidis.—Cantharides, 1; alcohol (90 per cent.), 80. Macerate. *Strength.*—1 in 81 of alcohol (90 per cent.).

Dos~~e, 5 to 15~~ m., or if frequently repeated, **2 to 5 m.**

7. Unguentum Cantharidis.—Cantharides, 1; benzoated lard, 10. *Strength.*—1 in 11.

ACTION.

External.—Cantharides is a **powerful irritant**, but it is slower in its action than most. If any of its preparations are applied to the skin no effect is noticed for two or three hours; then a tingling burning pain is perceived. Soon the part becomes red from vascular dilatation, the drug now producing its rubefacient effect. The next stage is the formation of several vesicles. These soon run together to form one large bleb full of clear serum. Not only is cantharides thus an **irritant and vesicant**, but it is a powerful **counter-irritant**, probably dilating by reflex action the vessels of the deep-seated organs under the point of application.

Cantharidin can be absorbed by the skin in sufficient quantity to produce internal effects.

Internal.—Cantharides is hardly used internally in medicine, as it is such a powerful irritant.

Gastro-intestinal tract.—It produces severe **gastro-intestinal irritation**, the patient suffering from abdominal pain, diarrhœa, and vomiting. There may be a burning pain in the throat; the motions and vomited matters may contain blood. These symptoms naturally cause much general depression.

Genito-urinary tract.—The active principle is absorbed into the blood, and a few hours after the gastro-intestinal symptoms have set in the patient complains of great **pain in the loins** and strangury—that is to say, there is an urgent desire to micturate; the effort is very painful from vesical tenesmus, and the quantity of urine passed is very small; it may contain **albumen and blood.** In severe cases of poisoning there may be greatly increased sexual desire, numerous seminal emissions, violent priapism, with swelling and heat of the genital organs. In women cantharides may cause abortion or induce menstruation. *Post mortem.*—Intense **gastro-intestinal inflammation** is present, consequently swelling, ecchymoses, and hyperæmia of the mucous membrane of the alimentary canal are observed. The **kidneys are found to be very congested** and in the early stage of acute nephritis. There is also much inflammation of the genito-urinary mucous membrane.

THERAPEUTICS.

External.—Cantharides is very largely employed to raise a blister, and it is of all drugs the most commonly used counter-irritant. It is applied to the chest in pleurisy, over the pericardium in pericarditis, over the inflamed nerves in neuritis, over the mastoid process in disease of the ear, over joints with chronic effusion into them, over the stomach when there is gastric pain, vomiting, &c. A blister applied over the nerve will often relieve pain in neuralgia. Cantharides is the basis of many preparations the object of which is to stimulate the growth of the hair, such as the following, Acetum Cantharidis, ½ fl. oz.; Glycerin, ½ fl. oz.; Spiritus Rosmarini, ½ fl. oz.; Water, 5 fl. oz. It will be noticed that the liquor, the collodion, and the emplastrum are the strongest preparations, that the acetum and unguentum are strong, but the tincture is weak. If a further counter-irritant effect is desired, the blister, which is usually pricked, may be irritated by the application of any irritating ointment; this, however, is very painful, and nowadays after the pricking some bland ointment is usually applied. The cantharides preparation should not be left on after the development of the bleb, lest the cantharidin should be absorbed. Cantharides should not be applied to a part on which the patient lies, or a bedsore may form; nor must it be used in renal disease; and it should be carefully employed in children or debilitated persons. It ought not to be applied to paralysed limbs.

Internal.—The drug is rarely given internally, but it has been used with success in small doses in cases of very chronic gleet. Sometimes it relieves chordee.

LEECHES.

Hirudo.—The Leech. Two species are official: (1) *Sanguisuga medicinalis*, the speckled leech (belly greenish yellow, spotted with black); (2) *Sanguisuga officinalis*, the green leech (belly olive-green, not spotted) (Nat. Ord. *Annelida*).

Characters of both species.—Body soft, smooth, 2 or more in. long, tapering to each end, plano-convex, wrinkled transversely; black olive-green, with six rusty-red longitudinal stripes. Each leech has a muscular disc at each end. In the centre of the anterior one is a triradiate mouth, provided with three jaws and two rows of teeth. A good specimen will remove 1–2 fl. dr. of blood.

Action and Therapeutics.

Leeches are used to remove blood. They are usually applied over deep-seated organs when they are congested, and great relief is often afforded. For example, three or four leeches over the liver when that organ is enlarged in heart disease, or one or two behind the ear when the tympanic cavity is inflamed, frequently do good. The leech being applied to the skin, the animal fixes itself by its sucker-like disc, makes a triradiate cut with its mouth, and draws into its body, which consequently becomes swollen, about a drachm and a half of blood. If this is not sufficient, a hot fomentation put on after the animal is removed may increase the quantity to half a fluid ounce. The skin should be well washed with a little milk before the leech is applied. Occasionally the hæmorrhage requires pressure or some local styptic, as perchloride of iron, to stop it. If leeches have to be applied to the mouth, rectum, or uterus, leech glasses, which only allow the head to protrude, should be used.

Diphtheria Antitoxin.—(Not official.)

When the bacillus of diphtheria grows in the body it produces toxins, albumoses, and an organic acid, and provokes the formation of a substance (called an antitoxin) which is found in the blood. This antitoxin is an antidote to the toxin of the diphtheria bacillus, and it is largely owing to the production of it that the patient is enabled to survive, and his chances of surviving are enhanced if antitoxin is administered to him to aid that which is formed in his body.

SOURCE.—Diphtheria bacilli are grown in a flask containing some nutrient broth (*e.g.* meat broth), to which 0·5 per cent. sodium chloride and 2 per cent. commercial peptone have been added. At the end of some weeks the bacilli are filtered off, and the fluid left contains a large amount of diphtheria toxin, and it should be of such a strength that $\frac{1}{10}$ c.c. of it will kill a good-sized guinea-pig. From $\frac{1}{5}$ to 1 c.c. of it is injected into a horse: this produces slight symptoms. As soon as they are past a larger dose is injected, and so the dose is gradually increased until 100 c.c. or more are given at each injection. This leads to the formation of a large amount of antitoxin in the blood serum. At the end of some months the horse is bled to 8 litres into a sterilized vessel, the blood coagulates, and the antitoxic serum is put into sterilized bottles and hermetically sealed, a little carbolic or other antiseptic being added to prevent decomposition.

Mode of Administration.—The antitoxic serum is always injected subcutaneously; usually between the shoulders or on the side of the abdomen. Before injection the skin must be thoroughly washed with an antiseptic. A special syringe, so constructed that all the parts of it can be boiled before use, is employed.

Dose.—It is better to give a small dose of a concentrated rather than a large dose of a dilute antitoxin. The strength of it is stated on the bottle, and therefore it must be obtained from a reliable source. The quantity given should be such that from 2000 to 4000 normal units or even more are injected in the first twenty-four hours after the patient comes under treatment. This amount may be divided into two or three doses, but should be repeated daily until the patient has improved considerably. A normal unit is ten times the amount of antitoxic serum that is just capable of neutralizing, within 48 hours, ten times the fatal dose of toxin when the two are simultaneously injected into the subcutaneous tissue of a healthy guinea-pig weighing from 250 to 300 grammes. The serum should contain at least 100 normal units in every cubic centimetre, but the best varieties are much stronger.

ACTION AND THERAPEUTICS.

Antitoxic serum diminishes all the symptoms of diphtheria, and in particular it greatly lessens the liability to sudden cardiac failure. If the diphtheria toxin be administered to animals fatty degeneration of the heart is found after death, but if they have also had antitoxin this is absent. Both clinical and experimental evidence show that after antitoxin is given, although the bacilli continue to exist in the throat, the formation of membrane ceases and that which is present rapidly disappears, the patient becomes less anæmic, his pulse improves, and his temperature may fall a little, although this is less influenced by antitoxin than are the other symptoms of diphtheria. The maximum effect of the antitoxin is not seen till twenty-four hours after injection. All reliable collections of cases show that the mortality, especially in children, is much less when the antitoxin is used. It should be given at the earliest possible moment, even if it is only likely that the patient is suffering from diphtheria. The benefit is more marked in laryngeal than in other varieties of diphtheria.

Poisoning symptoms are sometimes seen after this antitoxin has been given, but they are unimportant. By far the most common is an erythematous rash ; it may appear as late as the end of the third week after injection, but it is usually seen at the end of the first week. In a few cases a second rash is observed after the first has faded. Usually it is a mere erythema, but it may be papular or urticarial. Pains in the joints and slight swelling of them are occasionally present, and sometimes slight pyrexia is seen.

Streptococcus Antitoxin.—(Not official.)

This is prepared on the same principles as diphtheria antitoxin. The virulence of the streptococci is increased by their passage through several rabbits; they are then grown on a medium which preserves their virulence. A horse is next treated with successive doses of cultivations of these living streptococci, each more potent than the former. At the end of a year the strength of the antitoxic serum of the horse is powerful enough for use. The dose varies with different specimens of antitoxin. It is always given subcutaneously.

ACTION AND THERAPEUTICS.

Our experience of the value of this antitoxin is limited, but it suggests itself as probably useful for those diseases which are principally due to infection by streptococci. Such are surgical septicæmia, disease of the middle ear, thrombosis of the lateral sinus, and puerperal septicæmia. Successful cases have been recorded of its use in these disorders, and perhaps it might be used with advantage in any of the many diseases in which streptococci can be found. It has been tried in erysipelas, but at present it is undecided whether it is beneficial.

Tetanus Antitoxin.—(Not official.)

This is prepared on the same principles as diphtheria antitoxin (q.v.), and is administered in the same way. No marked success has attended its use, perhaps because tetanus is not usually diagnosed till long after infection.

Antivenomous Serum.—(Not official.)

Horses are rendered immune to the poison of the cobra by repeated injection, and Calmette and Fraser have shown that the hypodermic injection of serum from such horses will cure those bitten by a cobra and also render persons immune to cobra poison.

Hydrophobia Antidote.—(Not official.)

A rabbit is inoculated from the spinal cord of an animal dead of hydrophobia, other rabbits are inoculated from this, and so through a series until the spinal cord (which is the chief seat of the virus in hydrophobia) contains a virus the incubation period of which is seven days. The spinal cord loses its virulence when exposed to the air, so that a series of spinal cords (each of which originally contained a virus the incubation period of which was seven days) can be prepared of greater or less virulence according to the time during which they have been exposed to the air. It is found that if a patient who has been bitten by a rabid dog is inoculated first with a rabbit's spinal cord of a low degree of virulence, and next day with one of a higher degree, and so on increasing the virulence of the injection, hydrophobia does not usually develop in him if the treatment is begun soon after the bite. The most convenient place (for the inhabitants of Great Britain) where the treatment is carried out is the Pasteur

Institute in Paris, and if the person bitten go immediately after the bite it is quite likely he will not suffer from hydrophobia.

Piperazin.—(Not official.)

This organic base is formed by the action of sodium glycol on ethylenediamine hydrochloride. It was originally thought to be the same as spermine, an organic ferment obtained from the testicle, but it is quite a different body. It occurs in small colourless crystals soluble in water. Outside the body it is a powerful solvent of uric acid, but Fawcett (Guy's Hospital Reports, vol. 51) and others have shown that the urine of a person taking piperazin will not dissolve uric acid, nor does it benefit gout. In spite of this evidence of its apparent uselessness it is much given, usually in 5 gr. doses of a granular effervescing powder dissolved in half a tumbler of water, and some gouty patients profess to be much benefited by it.

APPENDIX No. I.

THE PHARMACOPŒIAL VEGETABLE DRUGS ARRANGED ACCORDING TO THEIR NATURAL ORDERS.

Nat. Order.	Name of Plant.	Part of Plant.	Name of Drug.
Ranunculaceæ	Aconitum napellus	Root	Aconite.
	Delphinium staphisagria	Seeds	Stavesacre.
	Cimicifuga racemosa	Rhizome	Cimicifuga.
	Hydrastis canadensis	" and roots	Hydrastis.
Magnoliaceæ	Illicium verum	Fruit	Oil of anise.
Menispermaceæ	Jateorrhiza columba	Root	Calumba.
	Chondrodendron tomentosum	"	Pareira.
	Anamirta paniculata	Neutral principle from fruits	Picrotoxin.
Berberidæ	Podophyllum peltatum	Rhizome and roots	Podophyllin.
Papaveraceæ	Papaver somniferum	Fruit	Poppy capsules.
	" "	Juice from capsules	Opium.
	" rhœas	Petals	Red poppy petals.
Cruciferæ	Brassica alba	Seeds	White mustard.
	" nigra	"	Black mustard.
	Cochlearia armoracia	Root	Horseradish.
Polygalaceæ	Polygala senega	Root	Senega.
	Krameria argentea	"	Rhatany.
	" triandra	"	"
	Rheum palmatum	"	Rhubarb.
	" officinale	"	"
Guttiferæ	Garcinia Hanburii	Gum-resin	Gamboge.
Ternströmiaceæ	Camellia thea	Alkaloid from leaves	Caffeine.
Malvaceæ	Gossypium barbadense	Hairs of seeds	Cotton wool.
Sterculiaceæ	Theobroma cacao	Oil from seeds	Oil of theobroma.
Lineæ	Linum usitatissimum	Seeds and oil	Linseed.
	Erythroxylum Coca	Leaves	Coca leaves.
Zygophylleæ	Guaiacum officinale	Wood	Guaiacum wood.
	" sanctum	"	"
Rutaceæ	Citrus aurantium	Peel and flowers	Orange peel and flowers.
	" medica	Peel and juice	Lemon peel and juice.
	Barosma betulina	Leaves	Buchu.
	Cusparia febrifuga	Bark	Cusparia or Angustura.
	Pilocarpus jaborandi	Leaves	Jaborandi.
Simarubaceæ	Picræna excelsa	Wood	Quassia wood.
Burseraceæ	Balsamodendron myrrha	Gum-resin from stem	Myrrh.
Celastrineæ	Euonymus atropurpureus	Root bark	Euonymus bark.
Rhamneæ	Rhamnus purshianus	Bark	Cascara sagrada.

NAT. ORDER.	NAME OF PLANT.	PART OF PLANT.	NAME OF DRUG.
Leguminosæ ...	Astragalus gummifer	Gum from stem	Tragacanth.
	Glycyrrhiza glabra	Root	Liquorice.
	Cytisus scoparius	Tops	Broom.
	Pterocarpus santalinus	Wood	Red sanders-wood.
	„ marsupium	Juice from trunk	Kino.
	Myroxylon pereiræ	Balsam from do.	Balsam of Peru.
	„ toluifera	„	Balsam of Tolu.
	Physostigma venenosum	Seeds	Calabar bean.
	Andira araroba	Exudation of stem	Araroba.
	Cassia acutifolia	Leaflets	Senna.
	„ angustifolia	„	„
	„ fistula	Pulp of fruit	Cassia pulp.
	Hæmatoxylon campechianum	Wood	Logwood.
	Tamarindus indicus	Pulp of fruit	Tamarind pulp.
	Copaifera Langsdorffii	Oleo-resin from trunk	Copaiba.
	Acacia senegal	Exudation of stem	Gum acacia.
Rosaceæ	Rosa gallica	Petals	Red rose petals.
	„ damascena	Flowers	Oil of Rose.
	Prunus amygdalus (dulcis)	Seeds	Sweet almond.
	„ „ (amara)	„	Bitter almond.
	„ domestica	Fruit	Prune.
	„ laurocerasus	Leaves	Cherry-laurel leaves.
	„ serotina	Bark	Virginian prune bark
	Quillaia saponaria	„	Quillaia bark.
	Brayera anthelmintica	Flowers	Cusso.
Hamamelidæ ...	Liquidambar orientalis	Balsam of bark	Storax.
	Hamamelis virginia	Bark and leaves	Hamamelis.
Myrtaceæ	Eugenia caryophyllata	Flower bud	Cloves.
	Pimenta officinalis	Fruit	Pimento.
	Melaleuca leucodendron	Oil from leaves	Cajuput oil.
	Eucalyptus globulus	„	Eucalyptus oil.
	„ rostrata	Exudation from bark	Red gum.
	Punica granatum	Root bark	Pomegranate root bark.
Cucurbitaceæ ...	Citrullus colocynthis	Fruit pulp	Colocynth.
	Ecballium elaterium	A sediment of the juice	Elaterium.
Umbelliferæ ...	Conium maculatum	Leaves and fruit	Hemlock.
	Ferula fœtida	Gum-resin from root	Asafetida.
	„ galbaniflua	Gum-resin	Galbanum.
	„ sumbul	Root	Sumbul.
	Dorema ammoniacum	Gum-resin from stem	Ammoniacum.
	Pimpinella anisum	Fruits	Anise.
	Coriander sativum	„	Coriander.
	Fœniculum capillaceum	„	Fennel.
	Peucedanum graveolens	„	Dill.
	Carum carvi	„	Caraway.

NAT. ORDER.	NAME OF PLANT.	PART OF PLANT.	NAME OF DRUG.
Umbelliferæ ...	Carum Copticum	Substance from oil	Thymol.
Caprifoliaceæ ...	Sambucus nigra	Flowers	Elder flower.
Rubiaceæ.........	Coffea arabica	Alkaloid from beans	Caffeine.
	Cinchona succirubra	Bark	Cinchona bark.
	Psychotria ipecacuanha	Root	Ipecacuanha.
	Uncaria gambir	Extract of leaves	Catechu.
Valerianeæ	Valeriana officinalis	Rhizome	Valerian.
Compositæ	Anacyclus pyrethrum	Root	Pellitory root.
	Artemisia maritima (stechmaniana)	Neutral principle from the flowers	Santoninum.
	Anthemis nobilis	”	Chamomile.
	Taraxacum officinale	Root	Dandelion.
	Arnica montana	Rhizome	Arnica.
Lobeliaceæ	Lobelia inflata	Herb	Lobelia.
Ericaceæ	Arctostaphylos uva-ursi	Leaves	Uva ursi.
	Gaultheria procumbens	Acid of oil	Salicylic acid.
Sapotaceæ	Hevea brasiliensis	Concrete juice	Caoutchouc.
Styraceæ	Styrax benzoin	Resin from bark	Benzoin.
Oleaceæ	Olea europæa	Oil from fruit	Olive oil.
Apocynaceæ ...	Strophanthus kombé	Seeds	Strophanthus.
Asclepiadaceæ	Hemidesmus indicus	Root	Hemidesmus.
Loganiaceæ......	Strychnos nux-vomica	Seeds	Nux vomica.
	Gelsemium nitidum	Rhizome	Gelsemium.
Gentianaceæ ...	Gentiana lutea	Root	Gentian.
	Swertia chirata	Plant	Chiretta.
Convolvulaceæ	Convolvulus scammonii	Root	Scammony.
	Ipomea purga	Tubercles	Jalap.
Solanaceæ	Capsicum minimum	Fruit	Capsicum.
	Atropa belladonna	Root and leaves	Belladonna.
	Datura stramonium	Seeds	Stramonium.
	Hyoscyamus niger	Leaves and flowers	Henbane.
Scrophulariaceæ	Digitalis purpurea	Leaves	Digitalis.
Labiatæ	Rosmarinus officinalis	Oil of flowers	Oil of rosemary.
	Lavandula vera	”	Oil of lavender.
	Mentha piperita	Oil from herb	Oil of peppermint.
	” ”	Substance from oil	Menthol.
	” arvensis		”
	” viridis	Oil of flowers	Oil of spearmint.
	Thymus vulgaris	Substance from oil	Thymol.
	Monarda punctata	”	”
Aristolochiaceæ	Aristolochia serpentarii	Rhizome	Serpentary.
	” reticulata	”	”
Piperaceæ	Piper nigrum	Fruit	Black pepper.
	” cubeba	”	Cubebs.
Myristiceæ	Myristica fragrans	Seeds	Nutmeg.
Laurineæ.........	Cinnamomum zeylanicum	Bark of shoots	Cinnamon.
	” camphora	Substance from wood	Camphor.
	Sassafras officinale	Root	Sassafras.
Santalaceæ	Santalum album	Oil of wood	Sandal-wood oil.

NAT. ORDER.	NAME OF PLANT.	PART OF PLANT.	NAME OF DRUG.
Cacteæ	Nopælea cochinillifera	Whole of plant	Cochineal insects reared on it.
Thymelaceæ ...	Daphne mezereum	Bark	Mezereon bark.
	„ laureola	„	„
	„ gnidium	„	„
Euphorbiaceæ...	Croton eleuteria	„	Cascarilla bark.
	„ tiglium	Oil of seeds	Croton oil.
	Ricinus communis	„	Castor oil.
Salicaceæ	Salix, various species	Glucoside of bark	Salicin.
Cupuliferæ	Populus „ „	„ „	„
	Quercus infectoria	Parasitic excrescences of Cynips gallæ tinctoriæ	Galls.
Urticaceæ	Ficus carica	Fleshy receptacles	Figs.
Cannabineæ......	Cannabis sativa	Tops	Cannabis indica.
	Humulus lupulus	Strobiles	Hops.
Scitamineæ	Zingiber officinale	Rhizome	Ginger.
	Elettaria cardamomum	Seeds	Cardamoms.
Iridaceæ	Crocus sativus	Stigma	Saffron.
Liliaceæ	Smilax ornata	Root	Sarsaparilla.
	Urginea scilla	Bulb	Squill.
	Aloë vera	Juice of leaves	Aloes.
	„ chinensis	„	„
	„ Perryi	„	„
	Schœnocaulon officinale	Seeds	Veratrina.
	Colchicum autumnale	Corm and seeds	Colchicum.
Graminaceæ ...	Triticum sativum	Grains	Starch.
	Zea mays	„	„
	Oryza sativa	„	„
	Saccharum officinarum	Cane	Sugar.
Coniferæ	Pinus sylvestris	Oil from exuded oleo-resin (turpentine), the residue is resin	Oil of turpentine and resin.
	„ „	Distillate from wood	Tar.
	Abies balsamea	Oleo-resin exuding from bark	Canada balsam.
	Pinus palustris	A variety of turpentine	Frankincense.
	„ pumilio	Distillate from leaves	Oleum pini.
	Juniperus oxycedrus	Distillate from wood	Oil of cade.
	„ communis	Oil of fruit	Oil of juniper.
	Picea excelsa	Resin from stem	Burgundy pitch.
Filices	Aspidium filix-mas	Rhizome	Male fern.
Fungi	Claviceps purpurea	Sclerotium	Ergot.

APPENDIX No. II.

A LIST OF LATIN PHRASES COMMONLY USED IN THE WRITING OF PRESCRIPTIONS.

aa.	Ana	of each.
Ad.	Adde	add.
Ad lib.	Ad libitum	to the desired amount.
Ad us.	Ad usum	according to custom.
Æq.	Æquales	equal.
Aq.	Aqua	water.
Aq. bull.	Aqua bulliens	boiling water.
Aq. dest.	Aqua destillata	distilled water.
Bib.	Bibe	drink.
Bis ind.	Bis indies	twice a day.
Bis in 7 d.	Bis in septem diebus	twice a week.
C.	Cum	with.
Cap.	Capiat	let him take.
C. m.	Cras mane	to-morrow morning.
C. m. s.	Cras mane sumendus	to be taken to-morrow morning.
C. n.	Cras nocte	to-morrow night.
Cochl.	Cochleare	spoonful.
Cochl. ampl.	Cochleare amplum	a table-spoonful.
Cochl. infant.	Cochleare infantis	a teaspoonful.
Cochl. mag.	Cochleare magnum	a table-spoonful.
Cochl. mod.	Cochleare modicum	a dessert-spoonful.
Cochl. parv.	Cochleare parvum	a teaspoonful.
Contin.	Continuetur	let it be continued.
Cuj.	Cujus	of which.
C. v.	Cras vespere	to-morrow evening.
Cyath.	Cyathus	a glassful.
Cyath. vinos.	Cyathus vinosus	a wine-glassful.
D.	Dosis	a dose.
d.	Da	give.
D. d. in d.	De die in diem	from day to day.
Det.	Detur	let it be given.
Dieb. alt.	Diebus alternis	on alternate days.
Dim.	Dimidius	one half.
Div.	Divide	divide.
D. in p. æ.	Divide in partes æquales	divide into equal parts.
Exhib.	Exhibeatur	let it be given.
F. or ft.	Fiat	let it be made.
F. h.	Fiat haustus	make a draught.
F. m.	Fiat mistura	make a mixture.
F. pil.	Fiat pilula	make a pill.
Gutt.	Gutta or guttæ	drop or drops.
Habt.	Habeat	let him have.
Hor. intermed.	Horis intermediis	at intermediate hours
H. s.	Horâ somni	at bedtime.
Ind.	Indies	daily.
Lat. dol.	Lateri dolenti	to the painful side.

Mit.	Mitte	send.
Mod. præscript.	Modo præscripto	in the manner directed.
O. m.	Omni mane	every morning.
Omn. bih.	Omni bihorâ	every two hours.
Omn. hor.	Omni horâ	every hour.
O. n.	Omni nocte	every night.
P. or pt.	Perstetur	continue.
Part. æq.	Partes æquales	equal parts.
P. r. n.	Pro re natâ	when required.
Q. l.	Quantum libet	as much as is requisite.
Q. s.	Quantum sufficit	a sufficient quantity.
Q. v.	Quantum volueris	at will.
R.	Recipe	take.
Rep.	Repetatur	let it be repeated.
Sing.	Singulorum	of each.
Sum.	Sumat or sumendum	let him take or let it be taken.
T. d.	Ter in die	three times a day.

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